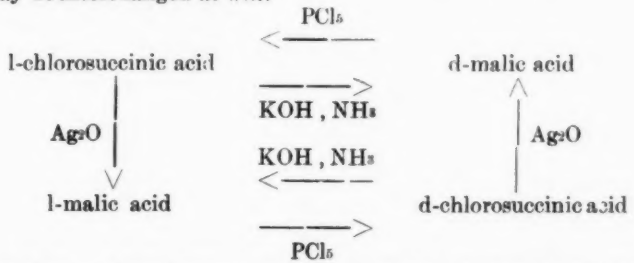
JOURNAL
OF THE
Elisha Mitchell Scientific Society

VOLUME XXVIII DECEMBER, 1911 NO. 4.

WALDEN'S INVERSION

BY ALVIN S. WHEELER.

During the years 1896 to 1899 P. Walden[1] published observations upon the behavior of optically active substances which were the most surprising in this field since the fundamental researches of Pasteur. The discoveries of Walden showed that it was not necessary to pass from an optically active substance to its racemic form in order to reach its antipode. He found that this inversion may take place directly. After 1889 Walden published no further work in this line nor did any one else pay attention to this unexplained phenomenon until 1905 when E. Fischer and O. Warburg[2] showed that the process could be employed with amino acids. The most important of Walden's researches is exhibited in the scheme below which shows a cycle of changes. It is seen that the sign of rotation of the active chlorosuccinic acid and malic acid may be interchanged at will.



The change of configuration was named by Fischer the Walden Inversion. If a reagent causes no change in the configuration, it

1. Ber.d. deutsh. Chem. Ges. **29**: 1896; **30**: 2795, and 3246. 1897; **32**: 1833 and 1855. 1899.
2. Ann. Chem. (Liebig), **340**: 191. 1895.

 Printed February 16, 1912

is said to act normally, whereas if it causes a change it acts abnormally. Owing to the uncertainty at times of the real configuration, it remains a matter of opinion whether a reagent acts normally or abnormally. It appears however that a single reagent may act in both ways, as Fischer has observed in the case of nitrosyl bromide which acts differently upon α-amino acids and their esters.

d-alanine + NOBr ———> l-bromopropionic acid

d-alanine ester + NOBr ———> d-bromopropionic ester

He also observed[3] a difference in the product with silver oxide.

l-bromopropionic acid + Ag_2O ———> l-lactic acid

l-bromopropionylglycine + Ag_2O ———> d-lactic acid

McKenzie and Clough[4] have noted recently that similar reagents may act differently. They found that l-hydroxy-phenylpropionic acid was converted by thionyl chloride into l-cloro-phenylpropionic acid whereas phosphorus pentachloride gave the dextro form.

All observations until recently have been confined to α-substituted acids. Lately Fischer and Scheibler have studied l-β-hydroxybutyric acid but were unable to prove an inversion. These authors announce the forthcoming publication of the observation that the hydroxyacid obtained from β-aminobutryic acid by the action of nitrous acid is optically different from that obtained by way of the chlorbutyric acid by the action of nitrosyl chloride. So far as noted the Walden Inversion is dependent upon the presence of a carboxyl group and the reactions are limited to the displacement of an amino group by means of a nitrosyl halide and to the displacement of a halogen group by an hydroxyl group or vice versa. Although there remain still many gaps to be filled, Fischer[5] has suggested an explanation of the phenomenon. As may be seen from the statements above, a Walden Inversion takes place when the configuration of the molecule changes as a result of substitution on an asymmetric carbon atom. Fischer believes that the inversion is a general phenomenon related very intimately to the mechanism of substitution. Whether a substitution is followed by a change in configuration depends upon the nature of the reaction and on that of the atoms linked to the

3. Ber. d. deutsch. Chem. Ges., **40**: 494. 1907.
4. Jour. London Chem. Soc., **97**: 2546. 1910.
5. Ann. Chem. (Liebig) **381**: 123. 1911.

asymmetric carbon atom. Since the antipodes possess a like energy content and therefore a like stability, there is an equal probability of either isomer being formed. The changes may be readily comprehended by the use of a new type of model devised by Fischer The carbon atom attached to an iron rod is entirely covered with steel bristles. The substituents consist of variously colored celluloid balls attached to corks which are covered on one side with steel bristles. A special system of two corks joined together and having three bristle surfaces is designed to represent subsidiary valencies. The mechanism of the changes is illustrated by employing the conversion of α-bromopropionic acid into the corresponding active amino acid by means of liquid ammonia, regarding the addition compound as consisting of one molecule ammonium α-bromopropionate and one molecule of ammonia. The balls 1, 2, 3, and 4 (Fig. I) represent the four groups H, Br,

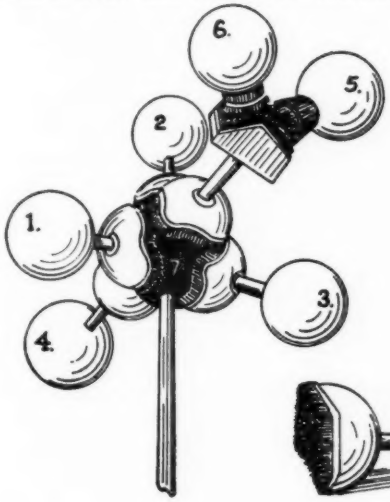


Fig. I.

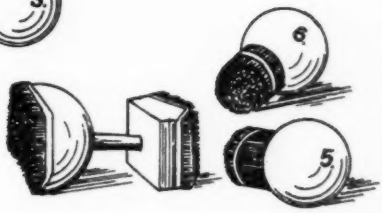


Fig. II

CH_3, and $COONH_4$, which are attached to the asymmetric carbon 7. The balls 5 and 6 signify the two parts of ammonia, H and NH_2 which are concerned in the substitution process. They are combined with the carbon atom by subsidiary valencies. The Figure II shows more clearly the arrangement of this group. If the halogen atom is set free and goes into the ionic form, the amino (NH_2) group may occupy its place. In this case no change has taken place in the configuration of the molecule. It may happen however that one of the other three substituents, 1, 3 or 4, will occupy the place of the halogen, leaving its place for the amino group. Here the configuration is changed and the Walden Inversion has taken place. If however both processes go on, then either a partial or a complete racemisation will occur.

The experimental part of this paper describes a Walden Inversion carried out by the author[6] in the chemical laboratory of the University of Berlin with E. Fischer and H. Scheibler. α-Bromoisocapronic acid was converted into the hydroxy acid, known also as leucine acid. We were able to resolve this into its active constituents with brucine, quinine and chinidine, the salt crystallizing out in each case being the laevo form. Chinidine proved to be the best agent. The l-leucine acid was also obtained, for comparison purposes, from l-leucine, by the action of nitrous acid. The ethyl ester of both the racemic and the laevo acid were prepared. Attempts to substitute the OH group in the l-ester were unsuccessful, PCl_5 and $SOCl_2$ being tried. However it was readily substituted by Br by means of Br and red P. The bromoester proved to be dextro rotatory. The action of NOBr upon l-leucine gives l-bromoisocapronic acid which yields the l-ester. The following scheme of changes shows that a Walden Inversion has taken place.

l-leucine + HNO_2 ——> l-leucine acid ——> l-leucine ester

l-leucine ——> l leucine ester + NOBr ——> d-bromoisocapronic ester

6, Ber. d. deutsch. Chem. Ges. **44**: 2684. 1911.

l-leucine + NOBr ——> l-bromoisocapronic acid ——> l-bromoisocapronic ester

Experimental Part

Preparation of dl-leucine Acid. One hundred grams of α-bromoisocapronyl bromide in 1357cc normal caustic soda were automatically shaken at room temperature until complete solution took place and then heated several hours upon a water bath until all bromine was ionized. The solution was now neutralized with 194cc normal H_2SO_4, considerably concentrated upon the water bath, supersaturated with 120cc 5N-H_2SO_4 and repeatedly extracted with ether. After distillation of the ether a mass of crystals mixed with a sirup remained. The acid was purified by conversion into its diffiultly soluble barium salt, recrystallizing it, decomposing it with H_2SO_4 and extracting with ether. The yield amounted to 39.8 grams or 78 per cent of the theory. It may be recrystallized by dissolving in ether and precipitating with ligroin. The acid crystallizes in rhombic tables which if slowly formed are very large. The melting point is 76-7°. The purity was established by analysis.

Resolution of dl-leucine acid into its optically active components. Thirty grams of dl-leucine acid were dissolved in 500cc water and mixed with a solution of 84g(1 Mol)chinidine, containing alcohol of crystallization, in 299cc of alcohol. The solution was concentrated to about 500cc and kept 15 hours at room temperature after impfing. The yield of the chinidine salt amounted to 45 gr, much of which was racemic. After two recrystallizations from very weak alcohol the yield amounted to 39g or about one half of the theoretical amount. This gave an acid of the rotation, $(\alpha)_D^{20} = 26.9°$ (in NaOH solution). This salt was nearly pure and was used for further work. The twice recrystallized, finely pulverized chinidine salt was shaken 15 minutes with an excess of normal NaOH. The filtrate from the separate chinidine was treated with an excess of H_2SO_4 and several times extracted with ether. After distillation of the ether the acid is recrystallized from ether + ligroin. It occurs in thin prisms and melts at 81-2°, with pro-

vious softening. The rotatory power of the sodium salt is greater than that of the free acid, the specific rotation being -27.8° as against -10.4°. The details of the analyses are here omitted. A pure dextro acid could not be obtained from the mother liquors, although it formed salts with other alkaloids. The highest rotation obtained was +11.9°.

Preparation of l-leucine acid from l-leucine. Five grams of l-leucine of rotation $(\alpha)_D^{20} = +15.8°$ (in a 5 per cent solution in a 20 per cent HCl) were dissolved in 57cc N-H_2SO_4 and treated at 0° with a concentrated solution of $NaNO_2$ (4g or 1.5 Mol.). The nitrite solution is added slowly during the course of a half hour. After standing 2 hours at 0° and three hours more at room temperature, the solution is extracted with ether and the hydroxy acid so obtained is converted into its barium salt. The acid thus purified had a rotation of $(\alpha)_D^{20} = -27.7°$. The yield amounted to 72 per cent of the theory. The action of nitrous acid is therefore smooth and proceeds without essential racemisation. The acid showed a melting point of 81-2°.

Optically pure d-léucine acid could not be obtained through resolution of the racemic acid but could be readily obtained by the action of nitrous acid upon d-leucine. The hydroxy acid so obtained gave melting point of 80° and a rotation of $(\alpha)_D^{20} = +26.3°$

Ethyl ester of dl-leucine acid. The method originated by Fischer and Speier was employed. Five grams of dl-leucine acid, dissolved in 15g absolute alcohol containing 0.22g HCl, were boiled 4 hours under a reflux condenser. The solution was pured into 5 parts of water, extracted with ether and the ethereal solution thouroughly dried over Na_2SO_4. After driving off the ether the ester distilled at 80-1° under 16mm pressure. The yield amouted to 4.85g or 80 per cent of the theory. The ester had a faint, pleasant oder, was difficultly soluble in water but easily in alcohol or ether.

Ethyl ester of l-leucine acid. The preparation of this ester was carried out exactly as that of the inactive ester. The properties were also the same. The rotation was $(\alpha)_D^{20} = -11.07°$. The ester yielded an hydroxy acid of rotation $(\alpha)_D^{20} = -26.9°$.

Transformation of the ester of dl-leucine acid into the ester of d-α

bromisocapronic acid. Many attempts were made to substitute the OH group by Cl by means of PCl_5 and $SOCl_2$ but without success. The introduction of bromine however was readily carried out. Two and one half grams of the dl-ester were well mixed with 0.5g red P, cooled by a freezing mixture and 3.7g Br slowly introduced. A vigorous evolution of HBr immediately took place. In order to complete the reaction the mixture was allowed to stand at 0° for three hours and then 15 hours at room temperature. The product was treated with water and sodium bicarbonate with simultaneous introduction of ice. The reaction mixture was extracted with ether and the ethereal solution dried with sodium sulphate. After driving off the ether the ester was twice distilled. It boiled at 86-7° under 11mm pressure. The yield amounted to 1.25g or 36 per cent of the theory. The same experiment carried out with the *l-ester* yielded the *dextro ester* of α-bromisocapronic acid. The boiling point was 91-2° at 18mm pressure. Two grams of the l-ester gave 1.0g of the d-bromester or 3.6 per cent of the theory. The ester showed a rotation of $(\alpha)_D^{20} = +40.0°$. The rotation of the ethyl ester or l-α-bromisocapronic acid as given by Fischer[7] is $(\alpha)_D^{20} = -43.1°$. This value however is too small since the acid employed was 16 per cent racemic.

All determinations of the rotation of the free acids were carried out in NaOH solution and in sodium light. The experimental details for l-leucine acid, for example, are as follows: 0.1321g substance were dissolved in N-NaOH. The total weight of the solution was 1.3307 g and density at 20° = 1.0144. The rotation at 20° and in sodium light in a 1dm tube was 2.88° (±0.02) to the left.

Chapel Hill, N. C.

7. Ber. d. deutsch. Chem. Ges., **40**: 502. 1907.

THE CREST OF THE BLUE RIDGE HIGHWAY

BY THOMAS F. HICKERSON.

Highways built primarily for scenic purposes are common in Switzerland, France, Germany, and many other countries of Europe, but they exist only to a limited extent in America, the most noted ones being the roads in Yellowstone Park, Yosemite valley, Adirondacks, the Crawford Notch Road in Newhampshire, and Vanderbilt's Road to Mount Pisgah.

The scheme for a scenic highway and a chain of hotels through the mountains of Western North Carolina, where the scenery is considered by many to be equal of any in the world, was thought out and put into effect through the efforts and influence of Dr. Joseph Hyde Pratt, State Geologist. The proposed location of this highway extends from Asheville to Boone, but the ultimate plen is to extend it, from Boone northward by Whitetop Mountain to Marion, Virginia, in order to connect with the Bristol-Washington Highway which passes by Roanoke and through the Shenandoah Valley, and Asheville southward by way of Hendersonville, Brevard, Toxaway, Highlands, Tallulah Falls, Ga., Cornelia, Ga., to a point on the National Highway, and thence to Atlanta.

There will be approximately 353 miles of the highway between Marion, Va. and Cornelia, Ga., nearly all of which lies in North Carolina. The following table gives the portions which are already graded and constructed etc.,

SECTION	Distance. (Miles.)	Part already constructed. (Miles.)	Part which follows an old road that may need to be revised. (Miles.)	Part which has not been constructed. (Miles.)
Marion, Va., to Boone, N. C.	75	.....	75	.....
Boone to Asheville	134	52	6	76
Asheville to Toxaway	64	64	.....	.....
Toxaway to Highlands	28	28	.....	.....
Highlands to Tallulah F., Ga.	30	.....	.....	30
Tallulah F. to Cornelia, Ga.	22	.....	22	.....
Totals	353	144	103	106

The total length of the Highway from Boone to Asheville, the part with which this paper deals, will be about 134 miles. Several sections have already been constructed, namely;

Boone to Blowing Rock	10 miles
Blowing Rock to Linville	22 miles (Yonahlossee Road)
Linville— Pineola— Grassland	
Brushy Creek Gap	13 miles
Mt. Mitchell Station to Little Switzerland	3 miles
Bull Gap to Asheville	10 miles
Total	58 miles.

About six miles of the road between Linville and Brushy Creek Gap needs to be revised, hence the total length of road to be constructed equals 82 miles.

Sixteen weeks of the last two summers have been spent in making a survey of the territory between Linville and Asheville. The part surveyed during ten weeks of the summer of 1910 under the auspices of the North Carolina Geological and Economic Survey extends from Linville to Buck Creek Gap. There were ten men in the party besides the cook and camp boy, the chief engineer was Mr. W. L. Spoon, who was then State Highway Engineer. The other members of the party were: T. F. Hickerson, Transitman; J. M. Costner, Levelman; N. C. Hughes, Levelman; R. T. Brown, Front Rodman and Chainman; M. L. Lasitter, Rodman; J. F. Speight, Stakesman; P. M. Smith, Level Rodman; Alex Feild, Chainman; and C. C. Brown, Rodman. All of the party were University of North Carolina men except Lasitter and Speight, who were C E. graduates of the North Carolina A. and M. College. The party lived eight weeks in tents and two weeks in boarding houses. The two camp sites were near wagon roads and only a few miles from the C. C. and O. Railway so that supplies were easily obtainable.

The survey during six weeks of the summer of 1911, under the auspices of the Appalachian Highway Co., of which Dr. J. H. Pratt is president, starts at Bull Gap (a deep gap 10 miles east of Asheville and 2 miles from Rattlesnake Lodge, Dr. C. P. Ambler's summer home, where the party spent ten days very pleas-

antly) and extends to Step's Gap, near Mt. Mitchell. There were eight in the party in addition to the cook and camp box, as follows: T. F. Hickerson, Chief Engineer; R. T. Brown, Transitman; P. M. Smith, Levelman; N. S. Mullican, Rodman; S. E. Barbour, Front Rodman; Geo. Strong, Level Rodman; Arthur Ambler, Stakeman; McKinley Pritchard, Chainman. All the members of the party were from the University of North Carolina excepd the last two mentioned. This section of the mountains embracing a portion of "Craggy" and the "Blacks" averages about 5000 feet in elevation and is wild, rough, and inaccessible. There were no wagon roads and scarcely any trails that could be travelled in safety with a horse. Moving from place to place the camp equipment, consisting of seven tents, ten folding cots, clothes and two double blankets for each person, a stove, cooking vessels, table ware, rations, and numerous other things, was a problem of transportation more difficult than any of the party had ever met before, since everything had to be packed on mules or portaged a distance of about seven miles over steep and rough trails. There were three camps; the first at Carter's Field near Craggy, the second at Balsam Gap, the third at Toe River Gap.

This party also had in charge the location and constructien of a horseback trail from Bull Gap to Step's Gap. It follows fairly closely the site of the Highway, but for the most part lies nearer the summit of the ridges and peaks. Mr. William Palmer and his party built this trail two feet wide at a price of $50.00 per mile.

Since the Highway is to be primarily a scenic road for tourists it was located as near the summit of the mountains as the maximum allowable grade, directness, and feasibility of construction would permit. No grades will exceed 41 1-2 per cent (which means 41 1-2 feet per 100 feet or 238 feet per mile). The width of the road will be at least 20 feet. The surface will be of earth or gravel or macadam, the last being necessary at some places on account of the scarcity of dirt and the abundance of loose rock. Much of the located route lies on the north side of the mountain because it was found that there is less declivity and far less rock on northern than on southern exposures to the sun.

The instruments used in making the survey were as follows: Aneroid barometer, Pedometer, Abney hand level, Gurley transit, and Engineer's level. Topographic maps made by the United States Geological Survey were very successful as a guide.

The first step in the preliminary survey was a walking trip over a few miles of the territory for the purpose of getting a clear idea of the topography with reference to the selection of the best route. Barometer readings were taken at controlling points, such as low gaps and summits of ridges where the scenery is especially good. Hand level readings were taken here and there to determine roughly the grades to various points. The next step was the exact location, by means of the hand level, of the route outlined during the reconnaissance. It often happened that several trial lines had to be run before the most feasible route could be determined. Huge solid rock cliffs with almost vertical faces were often encountered. This necessitated either a raising or lowering of the grade line in order to dodge them. Fortunately this was done in every case without exceeding a 4 1-2 per cent grade. In several places narrow ledges of solid rock could not be avoided and hence considerable blasting will be necessary for short distances.

Loops were resorted to as seldom as possible and were always located so that the turn was made on comparatively flat ground where excessive excavation would not be required. In about a dozen places between Linville and Asheville loops were introduced to reach a low gap, or cross a ridge, or surmount a rock precipice.

When the most suitable route was finally established after due consideration had been given to directness, economy of construction, and scenic advantages; the transit, level, and cross section parties came along with two or three axemen and made an accurate instrumental survey of the located line, so that a map showing the plan, longitudinal profile, and transverse profiles at intervals of 100 feet can be drawn, from which an estimate of the cost can be made. Notes were made of stream crossings, property lines, character of the soil, amount of rock, extent of forest and open ground, and all points of interest.

The average grade along the whole location is about 4 per cent. This means that there are practically no level grades. If two

gaps, one mile apart, had the same elevation it would make the route more direct in most places to run up on 4 per cent. half way and down on 4 per cent. half way instead of running on a level the whole distance, on account of the fact that the spur ridges and coves are much wider and deeper lower down on the mountain.

The maximum and the average altitudes of the various sections of the Highway between Boone and Asheville are as given below:

SECTION	Distance. (Miles.)	Elev. Max. (Feet.)	Elevation. (Feet.) Av.
Boone to Blowing Rock	10.0	3500	3360
Blowing Rock to Linville	22.0	4000	3800
Linville to Altapass	25.5	4100	3700
Altapass to Little Switzerland	6.5	3300	3000
Little Switzerland to Buck Creek Gap	12.5	3800	3500
Buck Creek Gap to Step's Gap	22.0	6200	4500
Step's Gap to Craggy Fields	13.0	6200	5700
Craggy Fields to Asheville	22.5	5500	3500
Total	134.0		

The location from Asheville to Boone in detail is as follows: beginning at Asheville, the proposed highway coincides with the road to the top of Sunset Mt., for a distance of five miles. A detailed description of this road, as seen in "The Manufacturer's Record," October 26, 1911, is as follows: "An exclusive automobile road, nearly all of which is 3 per cent. grade, with none greater than 5 per cent., beginning at the foot of Sunset Mt., near the end of Charlotte street, Asheville, and winding around the face of the mountain to its summit, has just been opened to the public oy Dr. E. W. Grove of Asheville and St. Louis. The entire length of the road to the summit has been laid with macadam. There are signs at approaches to all curves to "Blow Horn", while at its intersection with the carriage road that also leads to the summit are signs giving notice that carriages are not allowed on this road. The carriage road over a different course also has signs advising the public that automobiles are not allowed

on it. The distance from the center of the city to the summit of Sunset Mt. over this road is five miles, and motoring over its smooth surface presents to the eye views of rare sublimity and grandeur. The consummation of the tourists enjoyment is attained when the summit of the mountain is reached. Here, at an altitude of 3119 feet above sea level and nearly 1000 feet above the city, is a spread of vernal beauty that encompasses rare delights of valleys and summits, and in the full look across the Asheville plateau there is a world of grandeur and a loveliness of setting that stretches away to the far off mountains in the west, where the majestic peaks of Pisgah, Richland Balsam, Cold Mountain and the Bald pierce the sky at altitudes of 5749, 6540, 6000, 5400 feet, respectively, with a dozen others ranging in height from 3100 to 5000 feet This automobile road connects at the Summit of Sunset with the Crest of the Blue Ridge Highway, which is to extend from Asheville to Blowing Rock, along the crest of the mountains, at elevations ranging from 3100 to 6200 feet above sea level."

Mr. E. W. Grove owns 700 acres of land including Sunset Mountan and intends building a big hotel on the summit of this mountain.

From Sunset Mountain the location extends to Bull Gap along an existing road which needs revision only for ½ mile; thence, around the north and west side of Richland Knob, Courthouse Knob, Lanes Pinnacle crossing ridges and curving in and out of coves to Potato Gap; thence, along the south side of Snowball Mt., through Carter's Field and onwards climbing a long loop on the western side of Craggy Knob to the edge of Craggy Fields, the favorite rendezvous for camping parties and the proposed site of a hotel; thence, through Craggy Gap around the west and north side of Craggy Pinnacle, the north side of Craggy Dome to the gap between the Dome and Bull Head; thence, up grade following near the summit of Bull Head Ridge for ½ mile reaching an elevation of 5700 feet, and then down grade with a succession of loops along another ridge, (locally known as Peach Orchard Ridge) leading to Palsam Gap, the beginning of the Black Mountain Range, and the dividing line between the Asheville water-

shed on the west containing 13,000 acres of magnificent timber consisting mostly of balsam which still make hiding places for a few bear and deer; thence, winding around the north side among the beautiful balsams, and following along the east side of Blackstock Knob in full view of Mt. Mitchell, the north side of Potato Knob, Clingman's Peak, Mt. Gibbs, to Step's Gap at an elevation of 6200 feet and about 1½ miles from the summit of Mt. Mitchell. This is the nearest point on the proposed highway to the Peak, but during the past summer a survey was made by Messrs. Chisholm and Osborne of Charlotte for a highway from Black Mountain (on the Southern Railway) up Walkertown Ridge along the east side of Graybeard and the Pinnacle of the Blue Ridge through Toe River Gap and Step's Gap to the west of Hallback and around the west side of Mt. Mitchell upwards to its summit.

The Mitchell monument, which is a zinc shell filled with loose rock, is the first thing of interest on the top of the mountain. The inscription on the monument is as follows: "Here lies in hope of a blessed resurrection the body of the Rev. Elisha Mitchell, a Professor in the University of North Carolina, who lost his life in the scientific exploration of this mountain, in the 64th year of his age, June 27, 1857."

The ownership of Mt. Mitchell is in dispute. The Connelly heirs have probably the best claim. A log cabin with a kitchen in one end and bunks in the other, was built on the top of this mountain during the past summer.

The section from Step's Gap by way of Toe River Gap to Buck Creek Gap has not yet been surveyed, though it is certain that it will follow somehow along the crest of the Blue Ridge from Toe River Gap eastward, in fact, the Blue Ridge will be followed all the way from here to Blowing Rock.

Beginning at Buck Creek Gap and running northeastward the location ties on the north and west side of the mountain until the summit is reached, it then follows along the crest of the ridge to the Blue Ridge Meadows; thence, mostly along the north side, around peaks, and across ridges to Gooch Gap; thence, through Bear Wallow Gap and by Little Switzerland to Gillespie Gap; thence, on a southern and eastern exposure partly along an old

tram road built by the C. C. & O. Railway to McKinney Gap, which is ½ mile from Altapass, the highest point on the aforesaid railroad; thence, across a ridge along Rose Creek for a short distance and then by the way of Hog Gap upwards by windings and loops to the top of Hump Back Mountain; thence, along the top of Hump Back and down on the western side to Brushy Creek Gap, about 2 miles from Linville Falls; thence, by the way of Altamont, Grassland, and Pineola to Linville; thence, along the Yonahlossee Road over the southern and eastern slopes of Grand-Father Mountain to Blowing Rock; thence, to the left of the Blue Ridge, along a graded road, which is at present a toll road to Boone.

Water is scarce along the route over Craggy and the Blacks. During the past summer, which was unusually dry in the mountains, several springs became dry. Sign boards giving the location of springs will be placed along the Highway.

Stone walls or wooden railings will be built along the edge of the road where the ground is dangerously steep below, also at the ends of loops.

The cost of building the 82 miles will amount to about $400,000 or roughly $5,000 per mile. The Yonahlossee road from Blowing Rock to Linville cost $1,100 per mile, and the road from Mt. Mitchell Station to Little Switzerland cost $3,300 per mile, but neither of these is wide enough. There is every reason to believe that this Highway will be completed within the next few years. Several railroads are interested and have promised to contribute liberally. Large amounts will be obtained from private subscriptions. Several of those living in the neighborhood of the road have already voluntarily offered to give as much as $500.

Every variety of scenery unsurpassed for its beauty and grandeur, comprising, as it will, extensive views into the Piedmont region, nearer views of deep valleys, and mountain tops, and ridges, with here and there a most attractive and beautiful waterfall and streams of clear crystal water penetrating the dense green forests, together with the invigorating air and refreshing breezes and other pleasures of local interest such as rhododendron, azalea, ferns, galax leaves, balsam, spruce, an abundance of chestnuts

and huckleberries and wild strawberries, trout-fishing, etc., will afford infinite enjoyment to the tourist.

The section of the Appalachian Mts. through which the crest of the Blue Ridge Highway will pass contains the loftiest peaks east of the Rocky Mts., with mountain slopes covered with a more varied fauna and flora that is found in any other section of the country.

In ordor to get an idea of the superiority of the scenery in Western North Carolina over that in New England we may note the following, from S. M. Dugger's book on "The Balsam Groves of the Grandfather Mountain".

Highest summit east of the Mississippi, Mitchell's Peak in North Carolina.....altitude, 6,711 feet,
Highest mountain in New England, Mount Washington in New Hampshire.....altitude, 6,285 feet,
difference, 426 feet.

Among the peaks jointly possessed by North Carolina and East Tennessee there are 23 which surpass Mt. Washington in height. In addition to these, there are 23 other mountains which exceed 6000 feet, but fall short of Mt. Washington; and there are still 79 others which exceed 5000 feet, many of them closely approximating 6000.

The completion of this "Crest of the Blue Ridge Highway" will render possible wonderful developments in the agricultural, mineral, forest, and water power resources of the mountains, besides attracting thousands of pleasure-seeking tourists. As a purely scenic highway, it is destined to become one of national importance.

Chapel Hill, N. C.

THE PLANT LIFE OF HARTSVILLE, S. C.

BY W. C. COKER

INTRODUCTION

South Carolina has been the home of several of the most prominent botanists of America. Thomas Walter, an Englishman by birth, who lived on the Santee River in the upper part of St. John's Parish; Stephen Elliott, of Charleston; H. W. Ravenel, of Pinopolis and later of Aiken,—these are honored names in the history of our science; nor are they by any means all who have made valuable contributions to the botany of the State. Dr. Francis Peyre Porcher, Dr. James McBryde, Dr. J. H. Mellichamp, and Prof. Louis R. Gibbes were all native South Carolinians and careful students of its flora. All of these men lived and worked in the lower half of the State, in fact all but two entirely below the Santee River. With the exceptions mentioned below, the flora of the northern and northeastern parts of South Carolina was left without any particular study, and knowledge of its composition has been largely a deduction from what was reported from similiar or adjoining areas. There is much work yet to be done before the composition and distribution of even the higher plants of the State can be said to be at all well known. Mr. Ravenel and Dr. M. A. Curtis did considerable work in the fungi, but with these exceptions the lower plants have been studied scarcely at all.*

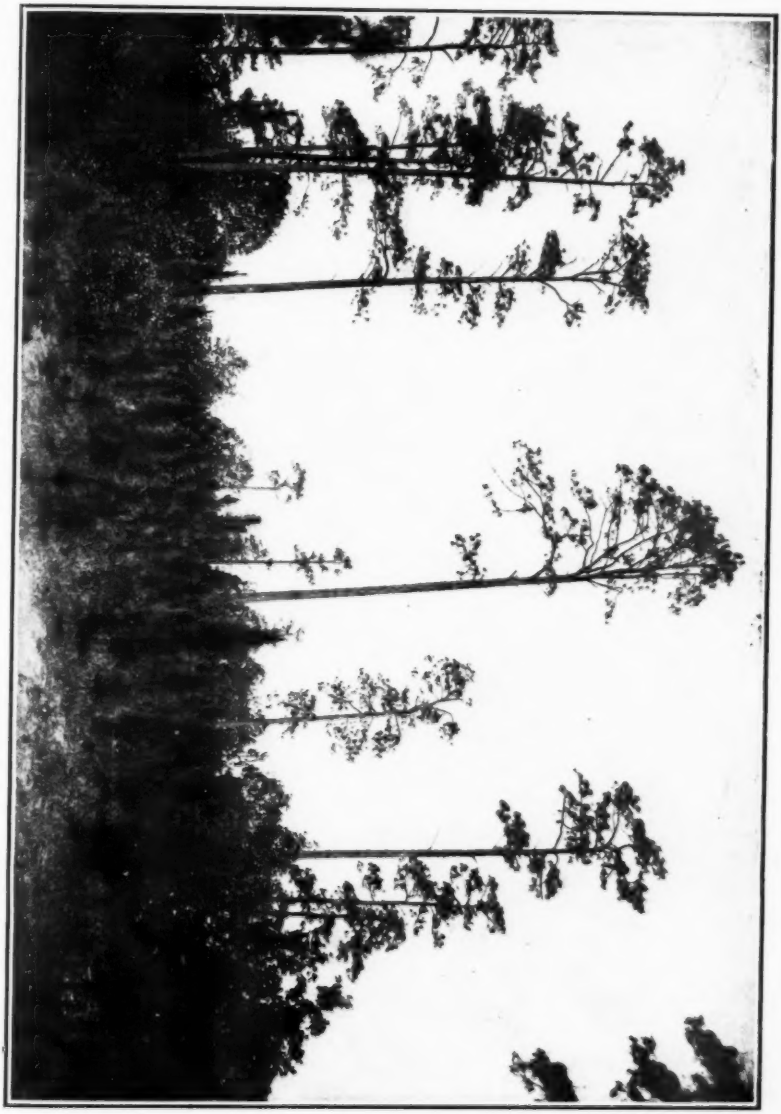
No catalog of the plants of South Carolina has ever been compiled. Elliott's book was called "A Sketch of the Botany of South

*Observations on the vegetation of South Carolina by the pioneering botanists of the early days,—travellers like Catesby, Bartram and the two Michauxs,—are of much interest and value, but they can be mentioned here only in passing. See also my articles in THE JOURNAL OF THE ELISHA MITCHELL SCIENTIFIC SOCIETY, as follows: "A Visit to the Grave of Thomas Walter," Vol. **26**, April, 1910. "The Garden of Andre' Michaux," Vol. **27**, July, 1911. "Dr. Joseph Hinson Mellichamp," Vol. **27**, May, 1911.

Carolina and Georgia," but none realized more than the author the necessary incompleteness of the work, especially for the upper part of the State. The local lists that have been published are those of Thomas Walter for the upper part of Berkeley County, of Prof. Gibbes for Columbia and environs, of Mr. Ravenel for the vicinity of the Santee Canal (being a part of Walter's territory), and of Dr. John Bachman for the neighborhood of Charleston.* At the end of his list of the more noticeable native and naturalized plants of South Carolina, in the volume on South Carolina published by the State Board of Agriculture in 1883, Mr. Ravenel gives the number of flowering plants known at that time in South Carolina as 1,810. A considerable number have been added since, and with a complete survey the total would probably reach over 2,100.

A history of the botanical work done in Darlington County can be written in a few words. As it lies somewhat off the direct line between Charleston and the North, or between Charleston and Columbia, few itinerant botanists have stopped in the district. Dr. Lester F. Ward passed through the county in 1895 and collected a few plants near the town of Darlington; and it is possible that Prof. Louis R. Gibbes of Columbia or Mr. H. W. Revenel may have picked up something here. However, I have not seen or heard of any specimens in their collections from this section. The botanical exploration of the county has been confined almost entirely to one man. Rev. M. A. Curtis, a gifted botanist of wide reputation, was for nine years (1847-1856) rector of the Episcopal church at Society Hill in the eastern part of Darlingten County, about seventeen miles from Hartsville. He gave his attention largely to fungi, and together with the Rev. M. J. Berkeley of England published a large number of new species in that group. However, he did not by any means neglect the flowering plants. He published no list of Society Hill

*In addition to these Dr. F. P. Porcher has published as a thesis for the degree of M. D., an extensive and valuable Medico-Botanical Catalogue of the "Plants and Ferns of St. John's, Berkeley, South Carolina;" and a paper by me on the Flora of the Isle of Palms, appeared in *Torreya* for August, 1905.



Young and old growth of Long-leaf Pine in the Sand Hills.

plants or any papers dealing exclusively with the flora of this region, but several new species of Angiosperms were described by him from Society Hill, among them being *Ilex Amelanchier* and *Baptisia Serenae*. Appreciation must also be expressed for the work of Mr. W. D. Woods, of Darlington, who through newspaper articles, correspondence and personal effort, has encouraged through a long life the study and preservation of our native trees.

CLIMATE OF HARTSVILLE

The altitude of Hartsville is 214 feet, its latitude about 34° 4m and 2sec., its distance from the sea about eighty miles. The town has no station of the weather bureau and no records of consequence are at hand. The climatological data may, however, be approximately guessed at from the records of nearby stations. For this purpose I give below a table containing the more important records for several of our nearest neighbors:

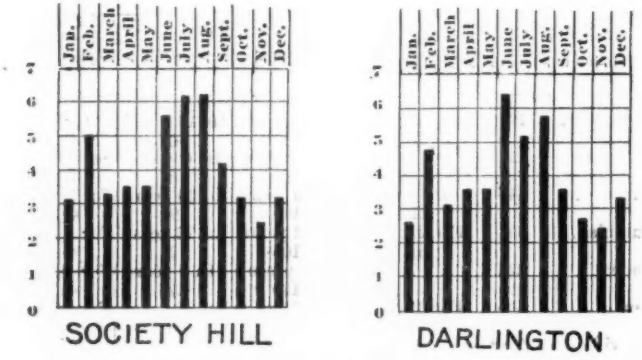
	Altitude in Feet	Mean Annual Temperature	Highest Temp.	Lowest Temp.	Mean Annual Precipitation
Society Hill.	192	For 18 years 61.8	In 18 years 100	In 18 years 0	For 17 years 49.31
Darlington .	155*	?	In 6 years 101	In 6 years 8	For 13 years 47.26
Cheraw.....	144	For 20 years 61.6	In 20 years 104	In 20 years 9	For 21 years 47.66
Columbia...	351	For 22 years 63.2	In 22 years 106	In 22 years 2	For 26 years 46.62
Camden ..	222	?	In 4 years 100	In 4 years 12	For 42 years 44.18
Aiken	565	For 25 years 63.9	In 25 years 107	In 25 years 3	For 26 years 46.43
Hartsville ..	214*				

From the data in this table the conditions at Hartsville may be very closely approximated. Darlington is about fourteen miles from Hartsville, Society Hill about seventeen miles, Camden about forty miles, but the temperature of the two last places is much nearer that of Hartsville than is that of Darlington. I would

*Elevation at the Atlantic Coast Line Railroad station as given by their survey. The weather bureau gives the altitude of Darlington as 175 feet. All other altitudes in the table are taken from the Weather Bureau reports.

guess that Hartsville is a little colder than Society Hill and the least bit colder than Camden. It is considerably colder than Darlington. As expressed by the vegetation there is a difference of nearly ten days in the coming of spring in Darlington and Hartsville, and there are some remarkable differences in the native vegetation. For example, the following coast plants are found wild or naturalized at Darlington but not at Hartsville: Carolina laurel cherry, or mock orange (*Prunus caroliniana*),‡ Darlington oak or laurel oak (*Quercus laurifolia*), Decumaria (*Decumaria barbara*) and Gray Moss (*Tillandsia usneoides*).† One small spray of the gray moss has been found hanging over Black Creek at Hartsville.

As the nearest available information in regard to the rainfall of Hartsville there are given below diagrams of the data for Society Hill and Darlington:



Diagrams showing the mean annual rainfall for each month at Society Hill (for the seventeen years preceding 1909) and for Darlington (for the thirteen years preceding 1909). From the U. S. Weather Bureau reports.

‡I know of about six trees of this species that have appeared spontaneously in or near the swamps and bays at Hartsville. In Darlington it has escaped abundantly.

†The non-occurrence of these plants at Hartsville is supposed to be due to a difference in climate. There are a number of others whose absence is due to soil characters, e. g., certain shrubs and trees of the Pee Dee Swamp.

There is no doubt that one of the principal factors influencing the distribution of species is the length of the growing season; and this may be determined by the mean occurence of the last killing frost in spring and the first killing frost in fall. The nearest stations to Hartsville for which this data is available are Cheraw and Florence. For Cheraw the average date of the first killing frost in fall is November 1st, and for the last killing frost in spring is April 5th. For Florence the dates are November 7th and March 31st. This would give a growing season of 209 days for Cheraw and 220 days for Florence. Hartsville's growing season would be nearer that of Cheraw's, say about 212 days.

There are no humidity records for this section of South Carolina, but I think there is no doubt that the humidity is less in the vicinity of the Sand Hills than in any other part of the State. It is almost certainly atmospheric dryness that accounts for the absence of the red cedar from this section, and that halts the gray moss at Darlington. The very rare occurrence, say once in twenty years, of cold waves that drop the temperature for a night or so to the neighborhood of zero seems to have little effect in determining the constitution of the flora. Length of growing season, atmospheric humidity, and mean lowest temperature are much more important.

The climatic position of Hartsville may be understood best, perhaps, when we consider the success or failure there of certain well known cultivated plants. A number of half hardy subtrophical species such as camellia (*Camellia japonica*), tea (*Camellia Thea*), camphor tree (*Cinnamomum camphora*), oleander (*Nerium oleander*), Cape jessamine (*Gardenia jasminoides*) may be successfully grown in the open, but our rarely occurring zero weather will injure them if unprotected. Oranges and other citrus fruits cannot withstand the average winters, but the new citrus hybrids, called Citranges, such as Morton, Willits, and Rusk, thrive and bear well.

TOPOGRAPHY AND GEOLOGY.

Hartsville is situated on the exact inner edge of the upper drier part of the coastal plain, marking, therefore, the northern boun-

dary of this great geographical division of the State. Just to the north of the town proper is the rapid descent of about 50 feet into the valley of Black Creek. This valley, with certain irregularities, extends for approximately one-half mile and is terminated on its northern edge by the outposts of the Sand Hills, which, gradually rising in gentle undulations, extend their barren prospect for miles to the northward. These Sand Hills are on the line that separates the Piedmont plateau from the coastal plain, and are a transition from one to the other. In their vegetation and geological origin they approach more closely to the character of the coastal plain. They were once much higher than they are at present, as is evidenced by the occurrence among them of a considerable hill, called Sugar-loaf Mountain, which rises to an elevation of 150 feet above the surrounding country and is capped by a layer of sandstone of sufficient strength to resist the extensive erosion that has elsewhere taken place. These hills mark the coast line of a Pleistocene sea that, shortly before the Glacial Epoch, halted here for thousands of years. An elevation then took place and the sea receded southward, exposing its level floor as our fertile and extensive coastal plain.

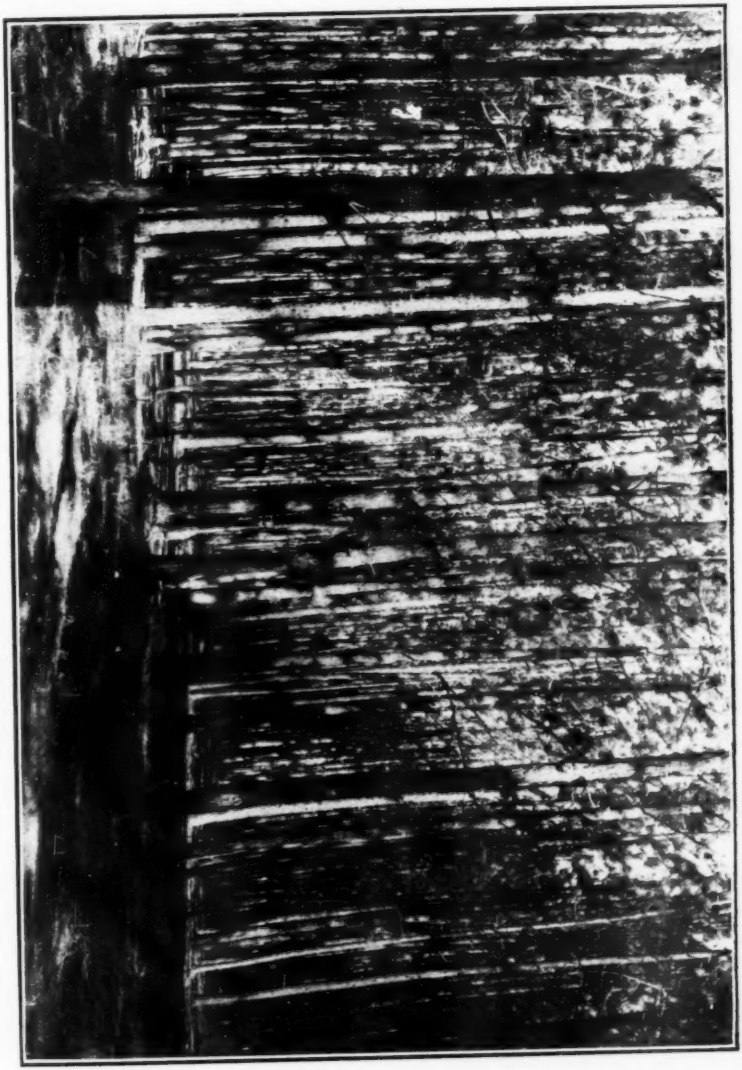
A cross section of the coastal plain in the neighborhood of Hartsville would show the following geological formations:

1st. RECENT. A surface layer of a few inches to a foot or more in thickness composed of a rather coarse gray, sandy loam, known as the Columbia sands.

2nd. PLEIOCENE? LAFAYETTE FORMATION, About 20 or 25 feet of variegated clays and sands, often highly and attractively colored. These may be seen at the big water cut across Home Avenue above Mr. McNair's place.

3rd. MIDDLE FRESH WATER CRETACEOUS: MAGOTHY FORMATION: Drab or black clays only a few feet in thickness, containing much lignite and vegetable matter. Many pieces of wood occur in this stratum, perfect in shape but very soft.

4th. LOWER FRESH WATER CRETACEOUS: POTOMAC FORMATION. This is the oldest of the coastal plain deposits, resting unconformably on the crystalline, igneous rocks below. It is characterized by absence of fossils, distinct banding, and the thickness of



Second growth of Long-leaf Pine in the Sand Hills.

its component layers of sands, clays, arkoses, gravels, etc. It is often stained with iron or other pigments, and mica is plentiful. It is from the sands of this formation that the artesian water that supplies the town is obtained. This water is as nearly pure as ground water can be, and its remarkable clearness and sparkle make it unsurpassed as a table water.

In the lower part of the county there is unterpolated between the Lafayette and the Magothy a deposit of Miocene marls of marine origin, and at places there are outcrops of this formation that have been worked for agricultural lime.

The general surface configuration of the country south of Black Creek valley is that of a remarkably level plain, with gentle elevations and depressions and occasional erosion cuts by the streams. As a result of this topography the surface drainage is often not good and open ditches are much used to empty pockets and lower the water surface in cultivated land. Except on a very few sandy knolls on the southern rim of the creek valley, that are really outposts of the Sand Hills, the nature of the vegetation on the level plain is determined very largely by the position of the water surface in the soil, and it is easily seen that the main ecological plant formations are dependent chiefly on this factor.

According to the United States Soil Survey of Darlington County there are in the immediate neighborhood of Hartsville five types of soils. The town itself is shown in their map as situated on the Orangeburg sandy loam, but there is evidently some mistake here* as this type is described in the text as containing "from 10 to 40 per cent. of water-worn pebbles, which rarely exceed the size of a man's thumb." As every one who lives in Hartsville knows, the soil does not contain such pebbles. Even the boy with the slingshot never found them out. This type is shown as extending to the foot of the hill towards the lake, and there being replaced by the Norfolk sand, which composes the flat valley, and with some interruptions extends up into the sand hills a mile or more, where it merges into the "Sandhill" type.

*The town really stands, I think, on the Norfolk sandy soil and the Goldsboro compact sandy loam.

The plantation immediately south of the town is of the Goldsboro compact loam type (according to the above-mentioned report), which may be said to correspond roughly to the flatwoods.

The plant formation that I describe as Well Drained Upland Forest, which should include, I think, most of the area covered by the town and the hill slope to the north, seems to be typically characterized by the type of soil called Norfolk sandy soil by the Survey.

In describing the vegetation of the region it will be best to distinguish the principal plant formations and then to take up each in turn. Including the sand hills, streams and swamps, as well as the various distinctive areas of the level uplands, we may distinguish in the vicinity of Hartsville as many as six ecological divisions or areas, as follows:

1st—THE SAND HILLS, OR PINE BARRENS.

The soils are extremely porous and composed very largely of sand, the surface specimen analyzed by the U. S. Soil Survey showed 94.78 per cent. coarse and fine sands and only 0.77 per cent. of organic matter. The subsoil is a yellow sand of the same texture, and of slightly higher clay content. In lower spots the proportion of humus is much greater and the soil is denser and damper.

2nd—THE WELL-DRAINED UPLAND FOREST.

The soil is that of the Norfolk sandy loam which is described as follows by the Survey:

It "consists of from 12 to 24 inches of a gray sandy loam, not unlike the soil of the Goldsboro compact sandy loam. A superficial examination might not suffice to distinguish the two types, but the subsoil gives rise to a variation in crop production which is quite evident. This subsoil is a sticky yellow loam or clay, which contains enough medium and fine sand, however, to render it much more friable than the subsoil of the Goldsboro compact sandy loam.

"There are a few areas of this type bordering large sand tracts, but its normal occurrence is as a narrow border, varying in width

from one-half mile to two miles along the smaller streams. As the stream is approached the sandy soil becomes deeper and the subsoil lighter in texture.

"On account of the position of this soil the drainage is generally good. The uncleared areas support a heavy growth of pine and the various hard woods common to the uplands of this section."

When cleared it makes an excellent type of farm land, but on account of the rather coarse texture it is somewhat inferior to certain of the more compact soils.

3rd—THE POORLY-DRAINED FLAT-WOODS.

These areas are somewhat lower than the preceding ones and are so extremely flat that the drainage is poor. The soil is Goldsboro compact sandy loam, and is thus designated by the Survey:

"The surface soil is an ashy-gray sandy loam, 10 to 20 inches in depth. There is usually a slight stickiness and coherency in this sand which distinguishes it from the [s]oil of the Norfolk sand. The subsoil is a tenacious and rather impervious clay loam, varying in color from yellow to dark gray. At lower depths the snbsoil becomes lighter in texture. The line of contract between soil and subsoil is well defined."

4th—THE SAVANNAS.

These conspicuous and interesting formations are undrained depressions in the flatwoods where the water stands at or above the surface for a considerable period of the year. The surface soil is a heavy, peaty, sandy loam and the subsoil is generally a dark gray sticky pipe clay that is almost impervious to water. In colder climates the savanna would probably be a Sphagnum bog.

5th—SWAMPS.

These may be devided into two sorts: the Shallow Swamps or Bays (often called "Galls" or "Gall Bays"), and the Deeper Swamps; and the Bays may be further divided into the alluvial or typical Bays and the non-alluvial or Flat-woods Bays. The typical Bay is a low, wet, alluvial area of deep, fertile, more or less muddy soil, rich in humus, with a pervious subsoil and some

surface drainage. In the lower areas slowly moving surface water is generally present in pockets and runs between the tussocks. The non-alluvial or Flat-woods Bay is a formation that occupies an intermediate condition between the Flat-woods and the Savanna. There is no drainage and the distinction is one of water content of the soil. The surface of the ground is almost saturated in rainy seasons, and damp and dry seasons, and the vegetation is quite different from either the Savanna or the Flat-woods. This is the formation that is called a "pocosin" in eastern North Carlina, although the term is used sometimes, it appears, to include the alluvial Bay (see Harper, Bull. Torrey Bot. Club, Vol. 34, page 361). The Deeper Swamp is like the alluvial Bay except that the surface is under water for a good part of the year. The bays are not subject to inundation and scouring from stream freshets and the deeper swamps are, and in its effect on the vegetation this is perhaps the most significant difference between them.

6th—STREAMS AND PONDS.

Here the vegetation is aquatic and is either free floating or attached to the muddy or sandy bottom.

It will be best to take up the plant covering of each of these types in turn.

VEGETATION.

THE SAND HILLS.

The covering of these hills is a thin open forest of two stories—the upper one of long-leaf pine (*Pinus palustris*) towering high below the scrubby growth below. In the original condition the pines were moderately close, but not enough so as to cast a dense shade. The magnificent trees extend their spreading crowns at an altitude of 75 to 100 feet and seem more sure of themselves and more in character here than in any other place. And in reality it is only in these barren hills that the long-leaf pine is holding its own against the constant encroachment of the old-field pine that now seriously threatens its supremacy tn all other parts of the coastal plain. For many years all the destructive powers of man have been waged against this most admirable natural product of the Southern States, until now there is scarcely anywhere to be found in an undisturbed fragment of the original sand hill forest.

A large specimen of Turkey Oak (Quercus Catesbaei).

The pines have been boxed and burned and cut for sawing until they are now only thinly scattered over the hills. But fortunately they are reseeding themselves quite well in many places, and with the observance of the most elementary principles of forestry they could be renewed and increased indefinitely.

The frequent woods fires are still more or less destructive to the young plants, but after close observation for a number of years I am now convinced that the idea expressed by W. W. Ashe in several of his bulletins* that this species is more susceptible to injury by fire than the old-field pine is entirely erroneous. It is true that its growth is so slow that when five years old the bud is usually but a few inches above the ground, but the very dense and abundant protective scales of the bud are wonderfully efficient in keeping out the heat from the delicate growing point. Moreover, the widely spreading mat of long, succulent, mature leaves that rest on the ground prevents the accumulation of inflammable material near the bud and thus greatly reduce the intensity of the heat. Early in the spring of this year, when all buds were dormant, a severe fire ran over the woods between Burnt Bay and Prestwood's Lake. During the first week in June the ground was looked over carefully for evidence on this point. The woods are rather open and a large number of young long-leaf pine had gotten started. The mature leaves were killed back almost or entirely to the bud, and were largely burned off, but I could not find a single plant even though an inch high that was not putting out its fresh young leaves from the unhurt growing point. On the other hand, nearly all of the young plants of the old-field pine were killed and many of them were four to six feet high. It is of course true that year old seedlings of long-leaf pine cannot resist hot fires, and the destruction of very young plants in the way is doubtless a great deterrent at present to the reforestation of the sand hills.

Gifford Pinchot was the first to call attention to the superior adaptations of the long-leaf pine to fire resistance. In the National Geographic Magazine for October, 1899, page 298, he says:

*See Bulletins N. C. Geol. Survey, No. 5, page 58; No. 6, pages 157-165, and No. 7, page 16. In these bulletins Mr. Ashe gives an excellent discussion of the long-leaf pine problem and of the methods necessary to secure the continued propagation of the forests.

"Almost all trees yield readily to slight surface fires during the first ten or fifteen years of their life. To this statement the long-leaf pine is a conspicuous and rare exception. Not only do the young trees protect themselves in early youth by bark which is not uncommonly as thick as the wood (the whole diameter being thus two-thirds bark and one-third wood), but they add to this unusual armor a device specially adapted for their safety when growing amid long grass, usually a most fatal neighbor to young trees in case of fire. It is to be noted that the vast majority of long-leaf pines are associated with grass from the beginning to the end of their lives. During the first four or five years the long-leaf seedling reaches a height of but four or five inches above the ground. It has generally been erroneously assumed that this slow growth makes it specially susceptible to injury from fire; but while the stem during these early years makes little progress, the long needles shoot up and bend over in a green cascade which falls to the ground in a circle about the seedling. Not only does the barrier of green needles itself burn only with difficulty, but it shades out the grass around the young stem, and so prepares a durable fire-resisting shield about the vitals of the young tree."

In his little book on "The Long-Leaf Pine in Virgin Forest," published in 1907, G. Frederick Schwarz discusses this point and calls attention to the exceptional fire-resistance of the long-leaf pine after the first two or three years of growth. On page 71 he says: "Without attempting to minimize the immediate and serious harm done to young growth, it may be asserted that the destruction of long-leaf pine seedlings by surface fires has been somewhat exaggerated and misunderstood; at any rate, so far as concerns seedlings over two or three years of age." And which admitting that one or two year old seedlings are destroyed as a rule by fires he says (page 72): that "After the seedlings have attained several years' growth they begin to offer wonderful resistance to surface fires." In the Bulletin of the Torrey Bot. Club, Vol. 38, p. 523, 1911, R. M. Harper says: "It is pretty well known that long-leaf pine, after it is four or five years old, is less affected by fire than almost

Upland Willow Oak (Quercus Cinerea) in the Sand Hills.

any other tree we have, and in Southern forests periodically swept by fire little else can grow but this pine and a great variety of more or less xerophytic, mostly perennial, herbs, among which various grasses are usually most abundant."

In the original condition of our forests the old-field pine was largely confined to the boundaries of swamps, bays and water courses. Over the remainder of the country the long-leaf pine was supreme. I think it probable that this condition was due principally to the fact that the long-leaf pine was able to endure the fires of the uplands, while the old-field pine was not. The latter was pushed aside to protected places. The present preponderance of second growth old-field pine in most thrown out land, outside of the sand hills, is probably due to two factors—1st, the infrequency of fires in cleared old fields, and 2nd, the insufficient seed production and limited seed distribution of the long-leaf pine. Given an equal chance and protection from fire and the old-field pine seems able to supplant the long-leaf pine from most of the good lands that it once occupied. It is different in the Sand Hills. There the soil is too poor to support the old-field pine and the long-leaf pine is given a free hand. Its present slow propagation there seems to be due as much to the scarcity and infrequent seed production of old trees as to fires, though these certainly do great damage, as mentioned above, in the destruction of young seedlings. The fact that the long-leaf pine can reproduce itself in the Sand Hills and is doing so abundantly in places is evidenced by the growth shown in Plates I and II.

Below the pines the rather low growth of the hills is composed most largely of several species of scrub oak. Among these the turkey oak, or fork-leaved black-jack, as it is more often called, (*Quercus Catesbaei*), is by far the most abundant, especially in the most barren places. It is almost always associated with broad-leaved black-jack (*Q. marilandica*), upland willow oak (*Q. cinerea*) and post oak (*Q. stellata*). The turkey oak and upland willow oak are typical sand hill species, but the other two occur also in more genial soils, where the latter reaches a much greater size. Though characteristically very small and scrubby the turkey oak may in the most favorable situations become a tree of considerable

proportions—say 40 feet high and 2 feet in diamater. One of the largest I know of is that shown in Plate III near the Baptist Church building.

The upland willow oak is the smallest of all our species. The largest specimen I ever saw is shown in Plate IV (a winter view). It is about 25 feet high and 14 inches in diameter. The association of this oak as shown in the picture will give a good idea of what is characteristic of sand hill conditions. Tall long-leaf pines are scattered in the back ground, and in middle ground are small trees of turkey oak, black jack oak, post oak, a few stunted persimmons, choke cherries (*Prunus serotina*), and sassafras bushes. Poison oak (*Rhus quercifolia*) and summer grape (*Vitis aestivalis*) were the only other woody plants. In August, 1910, the flowers in bloom around this tree were *Vernonia graminifolia*, *Liatris pauciflora*, *Chrysopsis graminifolia*, *Dasystoma pedicularia* (fly poison) and *Ascyrum hypericoides*.

In the most barren knolls of the hills, where the sand is purest, about the only trees that can stand the conditions are the long-leaf pine and the turkey oak. And there is no shrub that can be said to be tolerant of such places. But where the slightest advantage in moisture is to be had the trees already mentioned can establish themselves, and a number of shrubs become characteristic components of the cover. Horse sugar (*Symplocus tinctoria*), stagger-bush (*Lyonia mariana*), sumach (*Rhus copalina*), and the summer grape (*Vitis aestivalis*) are frequent. The Carolina holly (*Ilex caroliniana*), a small shrub with large deep red, shiny berries, is also a member of this community, but it is rare, in fact one of the rarest Hartsville shrubs. It will grow in much damper soil, as for example in front of the Upper Farm Place on Home Avenue.

Bear grass (*Yucca filamentosa*) and rattlesnake master (*Eryngium aquaticum*) require slightly damper soil than the preceding group. They are usually to be found near the foot of slopes that descend to water courses and bays. But I have found the rattlesnake master in very dry places at times, and also in almost saturated soil. Another little shrub that can endure almost the extremes of both drought and moisture is the low black huckleberry

Pine and Oak woods below Captain Cannon's Residence.

(*Gaylussacia dumosa*). This plant can flourish under a remarkable range of conditions. It is as much at home on the damp edges of savannas, associated with *Lycopodium adpressum* and *L. carolinianum* as it is in the sand hills in company with the scrub oaks. Next to the pines and oaks there is nothing so at home in the sand hills as the wire grass (*Aristida stricta*). Its grayish-green, terete, wiry, recurved leaves form large tussocks thinly scattered in the sand. Frequently there is so little other growth that the pure white sand may be seen from a long distance shining under the trees.

The sand hills are not without their share of attractive flowers; in fact, with the exception of the savannas they are the most colorfull of the floristic regions of our section. In early spring all except the most barren places support a good display of violets and bluets (*Houstonia caerulea*), shoe strings (*Cracca virginiana*), and the dainty little dwarf iris (*Iris verna*). Arbutus (*Epigaea repens*) is also very frequent here, and lovely in early spring. Wild phlox (*Phlox Hentzii*) and the blue flowered lupine (*Lupinus diffusus*) are very conspicuous, but occur only rather sparingly in scattered patches. At several spots in the hills there have been discovered in recent years a number of colonies of that most charming little carpet plant, *Pycidanthera barbulata*, called flowering moss. It has been known before only from the pine barrens of New Jersey and North Carolina.* In summer there is a continuous series of bloom that reaches its height in August, with a number of conspicuous composits, such as *Chrysopsis graminifolia*, *Chrysopsis aspera*, *Chrysopsis pilosa*, *Vernonia augustifolia*, *Aster concolor*, *Silphium compositum*, *Coreopsis delphinifolia* and species of goldenrod.

Other characteristic herbs of the hills are *Stillingia sylvatica* (queen's delight), *Cracca ambigua*, *Cracca spiccata*, *Amorpha herbacea* (lead plant), *Indigofera caroliniana* (wild indigo), *Astragalus apilosus*, *Hieracium Gronovii*, *Carduus repandus* (thistle), *Breweria trichosanthes*, *Baptisia tinctoria*, *Asclepias tuberosa* (butterfly weed) *Tragia urens*, *Euphorbia Ipecacuana*, *Euphorbia Curtisii*

*See my article in Torreya, Vol. II, page 9, Jan., 1911

Euphorbia maculata. *Penstemon laevigatus*, *Onosmodium virginianum*, *Paspalum setaceum* and *Stenophyllus capillaris*. There is a small sedge (*Cyperus Martindalei*) that is also abundant here, but it had not before been reported from the State.

THE UPLAND FORESTS

The vegetation of the well drained upland forests of this section has been largely cleared away, but certain areas still remain that exhibit to some extent the primitive conditions. Originally it was as in the Sand Hills, a two storied forest with long-leaf pine as the dominant, but not the most abundant tree. Most of the pines have now been felled, but the vigorous and luxuriant growth of broad leaved trees that reached almost to the lower limbs of the pine crowns has been scarcely changed. The oaks are the dominant factor now, as they are in the Sand Hills, but are of different species. The Spanish oak (*Quercus falcata*) and black oak (*Q. velutina*) are the largest and by far the most numerous trees. Both of these oaks are of fine proportions, often reaching a height of seventy feet and a diameter of 3½ or 4 feet. Next in abundance come the post oak (*Q. stellata*) and white hickory (*Carya alba*). The former, which in the Sand Hills is scrubby or even bushy, is here a large tree, second only to the black, scarlet, and Spanish oaks. The scarlet oak (*Q. coccinea*) is a rare but beautiful member of this community. There is a very large old tree of this species on the lawn of the old Law Place (now the residence of Mr. A. M. McNair).

Among the smaller trees dogwood is abundant, and pignut hickory (*C. glabra*), persimmon (*Diospyros virginiana*), sassafras, and choke cherry (*Prunus serotina*) are frequent. There are few shrubs except in open places, where sumach (*Rhus copalina*), red-haws (*Crataegus uniflora*), cow itch (*Tecoma radicans*), and Jersey tea (*Caenothus americana*) are common. The slope of the hill towards the creek supports a fine forest which exhibits well the transition from the dryer to the damper well-drained soil. Its crown is covered with the growth just described, but on the slope there appear a few scattered trees of short-leaf pine and old-field

Sparkleberry (Vaccinium arboreum) under Old Field Pine (Pinus Taeda).

pine, and there is more dogwood (*Cornus florida*), choke cherry (*Prunus serotina*), sumach (*Rhus copalina*), and Jersey tea (*Ceanothus americana*). There were once a number of chinquapin bushes (*Castanea pumila*) on this hillside opposite Burnt Bay, but they are now nearly all gone.

At the foot of the hill behind the residence of Capt. E. W. Cannon there are several acres of well-drained fertile land that slopes gently toward the lake, and supports an untouched forest that exhibits well a slight modification of the conditions just described. In Plate V is shown a photograph of this spot. The old-field pines are very tall and fine and rise far above the hard-wood growth of oak, hickory, etc., with gums and holly near the lake. In the center of the photograph is shown a fine post oak with wide spreading branches. The lower woody growth is most conspicuous for its very fine dogwood (*Cornus florida*) and sparkleberry (*Vaccinium arboreum*). The latter is as luxuriant and abundant as I have ever seen it, and in places almost forms thickets, as shown in Plate VI. It here composes about all the undergrowth and is twelve to fifteen feet high.

Where the two paper mill roads go down the hill there are scattered specimens of the pretty little dwarf flowering locust (*Robinia nana*), one of our rarest shrubs. On newly deposited soil near gully washes, etc., one may occasionally find catalpa trees (*Catalpa bignonioides*) and red mulberry (*Morus rubra*), both probably introduced and not native. The bullace grape (*Vitis rotundifolia*) and the summer grape (*Vitis aestivalis*) are quite plentiful in these woods, as they are in most places that are not too wet. Wild "honeysuckle" (*Azalea nudiflora*) is also found here but is more at home in the flatwoods. As the foot of the hill is reached and the soil becomes more moist the appearance of holly, (*Ilex opaca*), yellow jessamine (*Gelsemium sempervirens*), horse sugar (*Symplocus tinctoria*), etc., indicates the transition zone to bay-margin conditions.

Beginning a little way above Captain Cannon's Place the swamp margin is bordered on the south side by more or less abrupt bluffs which may reach the entire height of the valley, as at the old Bacot Place. The vegetation of these bluffs represents the most

northern element of our flora. Here is Mountain laurel (*Kalmia latifolia*) in profusion, and the rare combination may be seen of kalmia trees adorned with luxuriant vines of yellow jessamine. Perhaps the most interesting plant of these bluffs is colt's foot (*Galax aphylla*), which occurs in plenty in several places, and reaches here its seaward limit so far as I can ascertain. Spotted wintergreen (*Chimaphala maculata*), heart leaf (*Asarum arifolium*), partridge berry (*Mitchella repens*), arbutus (*Epigaea repens*), snake root (*Aristolochia serpentaria*), calamint (*Clinopodium carolinianum*), witch hazel (*Hamamelis virginica*), and sourwood (*Oxydendrum arboreum*) are attractive plants that occur here at their best. At two or three places along these bluffs, as at Laurel Land and below the paper mill, the remarkable little trailing huckleberry (*Vaccinium crassifoliam*), with firm, oval, evergreen leaves is found.

In Plate VII is shown the vegetation of these bluffs as it appears at Laurel Land. Mountain Laurel (*Kalmia latifolia*) is in the foreground, holly (*Ilex opaca*) and white oak (*Quercus alba*) in the background.

At the top of the high bluff behind the Bacot place there are a few escaped trees of mock orange (*Prunus caroliniana*) and Chinaberry tree (*Melia Azedarach*). As in the case of the peach, such occasional escapes as this do not entitle these trees to a place among the naturalized flora of the section.

To one accustomed to more northern conditions the most striking peculiarity of our rich woods is the almost entire absence of the conspicuous early spring flowers that show their attractive colors before the sun is cut off from them by the leafing of the trees. We have no anemones, hepaticas, or bloodroot, or giant chickweed, or spring beauty, or dogtooth violets (which are not violets at all). The hills and savannas have considerable color from herbaceous plants, but the deeper woods get most of their spring charm from the woody plants, as kalmia, yellow jessamine, dogwood, and azalea.

THE FLATWOODS.

A transition from the well-drained forest to the more pronounced flatwoods may be noticed in the pine grove to the right of Home

Kalmia, Holly and White Oak at Laurel Land.

Avenue, in front of the Upper Farm Place. Here for the first time we find a considerable amount of the short-leaf pine (*Pinus echinata*), and with it are associated long-leaf pine and old-field pine. Among these I was surprised to find a large tree of pond pine which is here in as dry a situation as I know of for the species (see Pond Pine under Hartsville trees). This is the only bit of level ground I have seen where these four coastal plain pines are to be found within a few yards of each other. Below the pines is a rather complete covering of shrubs and small trees. In addition to black oak and spanish oak there is water oak (*Quercus nigra*), willow oak (*P. Phellos*) and some black jack (*Q. marylandica*). One of the most conspicuous things about the grove is the large number of young holly (*Ilex opaca*) trees which are more abundant here than in any place I know of near Hartsville. The other trees are dogwood, white hickory, sassafras, choke cherry and persimmon. The shrubs are sparkleberry (*Vaccinium arboreum*), which is in great abundance, Carolina holly (*Ilex caroliniana*), red haw (*Crataegus uniflora*), and another species of *Crataegus* not yet determined. The perennial and almost shrubby little calamint (*Clinopodinum carolinianum*) is abundant. Yellow jessamine, bullace grape and summer grape are the only vines.

The re-seeding of the three species of pine in this grove is a point of considerable interest. There is abundant reproduction of the short-leaf pine, less of the old-field pine and a little of the long-leaf pine. Most of the young growth is in the more open places, but even in quite shady spots among the shrubs there are a large number of slender, delicate and struggling little short-leaf pine plants that grow about three inches a year and when ten years old are often not thicker than a lead pencil. Among the young long-leaf pines that were scattered here and there were some that were withstanding a shade so dense as to seem quite prohibitive to such sun-loving plants. One of these young trees is shown in Plate VIII. It is growing in a dense clump of sparkleberry bushes and short-leaf pine saplings. over which is a canopy of bullace grape vines. The extent of the shade is indicated by the occurrence around the foot of the pine of clumps of moss and of a number of plants of pipsissewa (*Chi-*

maphila maculata). This little pine is at least twelve years old and is only three feet three inches high, but it is far more stocky and vigorous than a number of young short-leaf pines near it, several of which had been killed by the shade. Another surprise was the finding in the same grove of a young long-leaf pine closely surrounded by hollys (*Ilex opaca*). In fact all one's previous experience in regard to the associations and requirements of the long-leaf pine seems controverted here.

Among the herbaceous plants in the grove are *Aster concola*, *Vernonia angustifolia*, *Lespedeza repens*, *Dolicholus erecta*, *Crotalaria Purshii*, *Lespedeza virginica*, *Lespedeza Nuttalii*, *Galactia volubilis*, *Stylosanthes riparia*, *Zornia bracteata*, *Baptisia tinctoria*, *Schrankia angustata*, *Polygala grandiflora*, *Euphorbia Curtisii*, *Dasystoma pedicularia* (fly poison), *Helianthemum majus*, *Lechea villosa*, *Lechea racemulosa*, *Lechea Torreyi*, *Chimaphila maculata*, *Hypoxis hirsuta*, *Erigeron ramosus*, *Hieracium venosum*, *Solidago odora*, *Vernonia angustifolia*, *Chrysopis graminifolia*, and *Sericocarpus bifoliatus*. On a ditch bank through an open field near here are a good lot of honey locust trees (*Gleditsia triacanthus*), a few hackberries (*Celtis crassifolia*), and a single small ash tree (*Fraxinus Darlingtoniana*), the only one I have found in the neighborhood of Hartsville.

For the typical low flatwoods I shall select for description that area lying directly south of the residence of Mr. J. E. Miller. Here the long-leaf pine is still present in considerable quantity in mixture with the old-field pine, which is the dominant tree of the flatwoods. The relative abundance of these two pines fluctuates very rapidly according to the slight dips and elevations of the surface, the long-leaf pine preferring the higher ground.

Originally the pines stood pretty close in the flatwoods, but in most places they have been so culled as to be now considerably scattered. The general effect is rather open. The willow oak is abundant, and is perhaps the most characteristic tree. The other arborescent growth consists of water oak, Spanish oak, black jack oak, post oak (a little), black gum, sweet gum, and persimmon. Beneath the trees the shrubbery is more or less clumped, with open

Young Long-leaf Pine in dense shade.

spaces between. The small gallberry (*Ilex glabra*) and the wax myrtle (*Myrica cerifera*) are the most abundant shrubs. The former is evergreen and in such open positions is rarely over three feet in height. On May 24th, 1909, it was in full bloom and its black berries of the preceding season were still hanging on in abundance. The wax myrtle is of two forms, a large shrub three or four feet high, that often stands close against the boles of the pines, and a small dwarf variety, one foot high or less, that runs extensively in open places. To this latter form Dr. J. K. Small has given the name of *Myrica pumila*. As there has been some doubt as to whether *M. pumila* is a species or merely a growth form of *M. cerifera* dependent on environmental influences, I undertook to settle the point by planting the two forms side by side both at Hartsville and at Chapel Hill, N. C. After several years each retains its character completely, thus proving at least a varietal distinction.

There is a good deal of the little stagger bush (*Lyonia mariana*) around the edges of the other shrubbery. It is very pretty when covered with its large, white, bell-shaped flowers. The only other shrubs noticed in this area were high blackberries (*Rubus Andrewsianus*) and sumach (*Rhus copalina*). Plate IX is a photograph of these woods.

As we pass through these flat woods in a southerly direction the surface gradually becomes more depressed and the soil damper until we enter a typical flatwoods bay, called a "pocosin" in North Carolina.* Its vicinity is marked by an increase in the number of gall-berry and wax myrtle bushes, and the appearance of *Azalea nudiflora* and clumps of catbrier (*Smilax rotundifolia*). In general aspect the flatwoods bay is much like the alluvial bay, but the tiers of vegetation are generally more sharply marked, there being fewer broad leaved trees of medium height to fill in between the pines and the shrubs. But there is considerable variation in this respect. So far as I know there are no bays around Hartsville where the growth is confined to the tall pines and a dense low undergrowth of mostly

*There is some difference of opinion as to exactly what a pocosin is. See Harper in Bull. Torrey Botanical Club, Vol. 34, page 361. 1907.

evergreen shrubs such as I have seen farther down the State near Lane's. The pines in our flatwoods bays are always old-field instead of pond pine, but with the exceptions mentioned below the appearance and constitution of the shrubby undergrowth is almost the same as in the alluvial bays. In addition to the pine the following trees, mentioned in order of abundance, are always present: black gum, sweet gum, red maple, sweet bay, and a little holly (*Ilex opaca*). Among the shrubs the two gall-berries (*Ilex glabra* and *Ilex lucida*) are by far the most plentiful, and next to these in quantity come the high-bush huckleberry (*Vaccinium corymbosus*) and cat-brier (*Smilax rotundifolia*). Choke-berry (*Aronia arbutifolia*) is also present in moderate amount and there is some bamboo-briar (*Smilax laurifolia*), though it is nothing like so plentiful here as in the alluvial bays. Blackberry (*Rubus Andrewsiana*) occurs on the ditch banks, but not in the body of the bay. *Zenobia pulverulenta* and *Zenobia cassinifolia* are two beautiful shrubs of the heath family that are partial to the flatwoods bays, but they are very erratic in their occurrence. They prefer the wet, undrained soil of these bays and are rarely found in alluvial bays,* but all flat woods bays do not contain them. They multiply by underground shoots and frequently from rather extensive patches, to the exclusion of other growth. In Plate X is shown a large clump of each of these species. *Zenobia pulverulenta* is at the right and *Zenobia cassinifolia* is at the left. Both are in flower, and a charming display they make. The point where this photograph was taken is not in the area just described, but in a somewhat similar flat across Black Creek about half mile below the paper mill. In the photograph there is shown some *Lyonia nitida* under the front edge of the large bushes, a slender plant of *Ilex lucida* projecting through the center of the right hand clump and *Ilex glabra* standing behind and to the left. In the immediate neighborhood were *Cyrilla racemiflora*, *Viburnum nudum*, *Aronia arbutifolia*, and small trees of pond pine, red bay, black gum, red maple, and sweet bay.

A comparison of the flatwoods bay or "Pocosin" and the alluvial or well drained bay will show the presence in the latter and

*See, however, page 195 for reference to their occurrence in alluvial bays.

Flatwoods showing Old-field Pines and a few Long-leaf Pines; undergrowth of Candle-berry (Myrica cerifera) and Gall-berry (Ilex glabra).

absence in the former of bamboo-brier (*Smilax laurifolia*), juniper (*Chamacyparis thyoides*), loblolly bay (*Gordonia lasianthus*), swamp azalea (*Azalea viscosa*), swamp wax myrtle (*Myrica carolinensis*). On the other hand the two *Zenobias* and cat-briar (*Smilax rotundifolia*) are found in the flatwoods, but are absent from the alluvial bay. There is the further difference in the Hartsville area of the dominance of the pond pine in the drained bay and of the loblolly pine in the flatwoods bay.

In the bay north-east of the old Lucas place through which the road passes there may be seen a beautiful example of transition from bay to savanna conditions. On the south side of the road near the center of this area the vegetation of the bay circles about and encloses a pretty little savanna of about a quarter acre in extent, where four or five cypress trees are standing on a grassy floor. This sudden change from the bay vegetation is due to a depression in the surface and an increase in the dampness of the soil in consequence.

THE SAVANNAS.

There are all gradations between the level flatwoods and the savanna formations, and there are savannas of every size from an acre or less to a number of square miles.

The savanna is a wet, undrained prairie or meadow with a scattered open cover of cypress and pond pine trees. There is practically no shrubby growth. In late spring and summer these savannas show the most conspicuous display of attractive flowers of any of our plant societies. In May and June the two species of swamp iris or blue flag *Iris versicola* and *Iris prismatica* are conspicuous and beautiful with flowers showing all shades of color from deep blue and lilac to light blue.

The most extensive savanna in Darlington County is the Big Savanna, east of Auburn, about six miles from Hartsville. The Atlantic Coast Line road runs directly across it. I have not had an opportunity to study this particular savanna, but from the train it seems to have the same sort of vegetation as the others I am more familiar with. However, on account of its large size, it is quite probable that it will show some peculiarities on closer acquaintance and I hope some day to make it a more extended

visit. The savanna most studied was the one on the back part of Major J. L. Coker's plantation, called "Plantation Savanna" in the herbarium labels. It is a small one, only about three acres in extent, and recent drainage has begun to change it a little. There is here, in addition to the cypress and pond pine, some black gum and sweet gum. The herbaceous cover is made up largely of grasses and sedges. *Juncus aristulatus* and *Rynchospora glomerata* when in fruit give a decided reddish color to considerable areas.

Among the most noticeable flowers of the savanna are *Pluchea bifrons*, *Ludwigia capitata*, *Stachys hyssopfolia*, *Polygala mariana*, *Polygala ramosa*, *Ludwigia hirtella*, *Eupatorium Mohrii*, *Diodia virginiana*, *Gerardia linifolia*, *Rhexia lanceolata*, *Rhexia mariana*, *Linum medium*, *Sabatia lanceolata*, *Oxypolis filiformis*, *Linaria canadensis*, *Dasystoma flava*, *Gratiola pilosa*, *Eupatorium semiserratum*, *Hypericum virgatum*, and *Boltonia asteroides*. In the flatwoods not far from here was found a little *Baccharis halimifolia*. It also occurs sparingly near Prestwood's Lake and the paper mill and seems to be getting more plentiful.

Just to the north of the dam at the paper mill are some low flats, that show almost the same herbaceous growth as a typical savanna. In the wettest spots grow *Typha latifolia*, a few trees of *Salix nigra*, the decorative *Scirpus Eriophorum*, *Juncus scirpoides*, *Juncus trigonocarpus* and *Mikania scandens*. Mingling with these and running out into slightly dryer places were *Rynchospora glomerata*, *Juncus aristulatus* (these two giving a red effect to the meadow with their fruits), *Fuirena squarosa* (very abundant), *Boemerea scabra*, *Hypericum virginicum*, *Eriocaulon decangulare*, *Lachnocaulon anceps*, *Limodorum tuberosum*, *Rhexia mariana*, *Linum medium*, *Linum striatum*, and *Eupatorium rotundifolium*. The somewhat less wet portions of the flats were covered with the following: *Cynoctonum sessilifolium*, *Gratiola pilosa*, *Buchnera elongata*, *Aletris farinosa*, *Spiranthes praecox*, *Hypericum setosum*, *Lobelia Nuttalii*, *Ludwigia hirtella*, *Burmannia capitata*, and *Rhexia lanceolata*. With these flourished large quantities of *Lycopodium adpressum*, and *Lycopodium alopecuroides*, and in the firmer, more sandy spots *Lycopodium carolinianum*. In the dryer parts were

Zenobia pulverulenta and Zenobia cassinifolia in flower.

Chrysopsis graminifolia, *Crotalaria rotundifolia*, *Gnaphalium purpureum*, *Rumex hastatulus*, *Psoralea pedunculata*, *Asclepias amplexicaule* and *Hypericum gentianoides*. On a ditch bank through this flat grew a good quantity of *Amelanchier Botraypium*, here not over two feet in height.

THE BAYS AND SWAMPS.

As the typical "Bay" of this section we may select the one called Burnt Bay, which runs along the southern side of Black Creek valley west of the novelty mill. It is covered with a dense growth of trees and shrubs of which so many are evergreen as to give a general effect of verdure at all seasons. On the edges there is old-field pine and a little long-leaf pine, but the typical pine of the bay, and the only one that extends through most of the deeper parts, is the pond pine. This grows much larger here than in the savannas, reaching a height of over seventy-five feet and a diameter of two and a half feet.

On the edges of the bay there is an attractive fringe of low shrubs that leads up gradually to the taller growth behind. Among these the two gall-berries (*Ilex glabra* and *Ilex lucida*) and the fetter bush (*Lyonia nitida*) are evergreen and so numerous are they proportionally as to give their hopeful winter color to the whole border. Abundant among these are the following deciduous shrubs: swamp azalea (*Azalea viscosa*), *Lyonia ligustrina* var. *foliosiflora*, sweet pepper bush (*Clethra alnifolia*), he-huckleberry or myrtle (*Cyrilla racemiflora*), Virginia willow (*Itea virginica*), swamp sumach (*Rhus Vernix*), swamp waxberry (*Myrica caroliniana*), the two 'possum haws (*Viburnum nudum* and *Viburnum cassinoides*), choke-berry (*Aronia arbutifolia*), the two high bush huckleberries (*Vaccinium fuscatum*, tall, berries black, and *Vaccinium corybosum*, tall, berries blue), high blackberry (*Rubus Andrewsiana*), and a little of the shad bush (*Amelanchier Botryapium*), called "wild currant" here. Yellow jessamine (*Gelsemium sempervirens*), climbs over this border in abundance, and just just behind it are great masses of the bamboo brier (*Smilax laurifolia*), one of the most beautiful evergreen vines in the world. Poison ivy (*Rhus Toxicodendron*), Virginia creeper (*Psedera quin-*

quefolia), and cross vine (*Bignonia capreolata*) extend throughout the bay, but the bullace (*Vitis rotundifolia*) is confined to the borders.

Next to the pine the largest trees of the bay are black gum (*Nyssa sylvatica*), juniper (*Chamaecyparis thyoides*) and red maple (*Acer carolinianum*). Water oak (*Quercus nigra*) is plentiful in the borders and shallower parts, and Willow oak (*Quercus Phellos*), while not a typical bay tree, is found in Burnt Bay where it edges off into the low sandy woods on the south side.

The most common evergreen trees of the bay are sweet bay (*Magnolia glauca*) and red bay (*Persea pubescens*). They are both extremely abundant and characteristic. The sweet bay is not entirely evergreen with us. There are specimens in Burnt Bay that reach the unusual height of 35 feet. The loblolly bay (*Gordonia lasianthus*) is not nearly so common as the two preceding, but is found scattered near the edges of nearly all bays. It is quite evergreen, and when covered with its fine white flowers it is one of our handsomest trees. Around the edges of Burnt Bay cinnamon fern (*Osmunda cinnamomea*) is plentiful, and there is a little bracken fern (*Pteris aquilina*) and royal fern (*Osmunda regalis*). In the deeper and more shady inner parts are scattered beds of chain fern (*Woodwardia areolata*), and in shallow standing water or mud is the large, coarse "poor man's soap" (*Woodwardia virginica*).

In the low damp woods along the north side of the bay grow old-field pine (*Pinus Taeda*), long-leaf pine (*Pinus palustris*), white hickory (*Carya alba*), dogwood (*Cornus florida*), sassafras (*Sassafras variifolium*), Spanish oak (*Quercus falcata*), willow oak (*Quercus Phellos*), water oak (*Quercus nigra*), and the following shrubs: sparkleberry (*Vaccinium arboreum*), *Vaccinium tenellum*, *Gaylussacia frondosa*, *Myrica cerifera*, *Lyonia mariana*, *Ascyrum stans*, and *Ascyrum hypericoides*. The pretty herbaceous vine called carrion-flower (*Smilax herbacea*) and the wild yam (*Dioscorea villosa*) are to be found in these woods. In an open damp meadow here (savanna conditions) was found *Juncus abortivus* for the first time in South Carolina. With it were *Rhexia virginica*,

Gratiola pilosa, *Gratiola virginiana*, *Bacopa acuminata*, *Ludwigia linearis*, *Xyris caroliniana*, and *Lobelia Nuttalii*.

The edges of Burnt Bay are in most places either too abrupt or too shady to admit of the best development of many of the attractive flowers that are often associated with bay conditions, although most of them may be sparingly found at places around its margin. For the study of such flowers it is best to cross over Prestwood's Lake to edges of the bays surrounding the savanna-like open area in Captain Cannon's sheep pasture (referred to in the list as "Sheep Pasture Savanna"). The meadow-like area of a couple of acres is low, moist, and sandy, but too well drained to show typical savanna vegetation. It is bounded on both sides by low bays and the transition between the bays and meadow show some interesting plants. Through the open area are scattered a few large trees of the pond pine (*Pinus serotina*) and long-leaf pine (*Pinus palustris*), which is the only aborescent growth except a few small plants of black-jack oak (*Quercus marylandica*), upland willow oak (*Quercus cinerea*), Spanish oak (*Quercus falcata*), and post oak (*Quercus stellata*). The open space was also dotted with scattered clumps of *Myrica pumila*, *Ilex glabra*, *Alnus rugosa*, *Vaccinium frondosum*, *Lyonia mariana*, *Lyonia ligustrina* var. *foliosiflora*, and *Clethra alnifolia*. Along the wetter edges of the bays the following shrubs made a dense and attractive border: *Zenobia pulverulenta*, *Zenobia cassinifolia* (a little), *Kalmia cuneata*,* *Vaccinium australe*, *Leucothoe racemosa*, *Leucothoe axillaris* (a rare and interesting evergreen), *Azalea viscosa*, *Ilex glabra*, *Ilex lucida*, *Aronia arbutifolia*, *Myrica cerifera*, *Myrica caroliniana*, *Lyonia ligustrina* var. *foliosiflora*, *Fothergilla carolina*, and *Lyonia nitida*. Just back of these the taller bay vegetation began with *Viburnum*

*This interesting little Kalmia seems to be represented in American herbaria only from southeastern North Carolina, and it is generally considered as confined to that State; but Mr. R. M. Harper has called my attention to the fact that F. A. Michaux (in his Journal for July 18, 1794), and Thomas Nuttall (in his "Genera of North America Plants," Vol. I, page 268, 1818) both mention its occurrence at Camden, S. C. See my "Additions to the Flora of the Carolinas. II." TORREYA, Vol. II, page 9, January, 1911.

nudum, *Viburnum cassinoides* and *Magnolia glauca* conspicuous on the border. The trees of the bays were red bay (*Persea pubescens*), black gum (*Nyssa sylvatica*), Carolina red maple (*Acer carolinianum*), and pond pine (*Pinus serotina*), and a little juniper (*Chamaecyparis thyoides*). Bamboo briar (*Smilax laurifolia*) and red-berried bamboo (*S. Walteri*) were plentiful. Partially submerged in an open piece of water in the bay were found *Juncus repens* and *Eleocharis Torreyana*.

In certain places on the east side the shrubby borders were replaced by a wet Sphagnum bog in which were masses of cinnamon fern (*Osmunda cinnamomea*) and fine conspicuous clumps of pitcher plants (*Sarracenia flava*). *Sarracenia purpurea* is also plentiful here in the Sphagnum, and *S. rubra* grows abundantly where the Sphagnum is less deep. Along this border five species of Orchids were found,—*Pogonia ophioglossoides* and *P. divaricata* (blooming on May 24th), *Limodroum graminifolium* (July 8),* *Habenaria blephariglottis* and *Habenaria ciliaris* (August 20th). In July *Rhexia mariana*, *R. lanceolata*, *R. ciliosa*, and *R. glabella* make a very bright effect with their handsome flowers, while in May the white flowered *Zyadenus angustifolius* and *Chamaelirium luteum* were conspicuous in the same place.

In the main body of the savanna where the soil was moist but not boggy grew *Rynchospora glomerata*, *Juncus aristulatus*, *J. trigonocarpus*, *Lacnocaulon anceps* (small "hat pin"), *Buchnera elongata*, *Marshallia obovata*, *Bartonia lanceolata*, *Tofieldia glabra* (blooming about Sept. 1st), *Xyris arenicola*, *Aletris farinosa* [a yellow Alestris, supposed to be *Aletris aurea*, was collected but lost], *Spiranthes praecox*, *Polygala lutea*, *Linum medium*, *Eupatorium rotundifolium*, *Eupatorium verbenaefolium*, *Ascyrum stans*, and *Aster squarrosus* (not seen in bloom). Towards the outer edge of the savanna where the soil was dryer grew *Seriococarpus asteroides* (said by Small to grow in rocky woods), *Lespedeza repens*, *Indigophora*

Limodorum tuberrosum also will no doubt be found here, but I did not happen to see it. It is rather plentiful in such situations in our region. A white flowered form of the species was found on the edge of another bay not far from this spot and we have seen it since in several places.

Upper part of Prestwood's Lake showing large dead Cypress trees.

caroliniana, *Vaccinium tenellum*, *Gaylussacia dumosa*, and *Lyonia mariana*. Farther up still, in the flat sandy pasture, *Stipulicida setacea* was collected.

THE DEEPER SWAMPS.

We have at Hartsville no swamps of the type found by the larger muddy rivers that are subject to frequent floods, as the Pee Dee and Santee, and many plants that affect such swamps are absent at Hartsville. Such, for example, are overcup oak (*Quercus lyrata*), elm (*Ulmus alata* and *Ulmus americana*), water hickory (*Carya aquatica*), tupelo gum (*Nyssa aquatica*), swamp chestnut oak (*Quercus Michauxii*), planer tree (*Planera aquatica*), and deciduous holly (*Ilex decidua*).

Our swamps and bays grade insensibly into each other, and the edges of all our swamps are bays. The typical bay would have a scattering cover of large trees with a dense tangle of undergrowth of shrubs and vines, largely evergreen. The typical swamp has a heavy cover of large trees (among which is always cypress) and a more or less open floor beneath. However, there are to be found on the tussocks and tree bases in the swamps nearly all the shrubs that have been described as making up the marginal growth of Burnt Bay.

As a good example of the typical creek swamp I shall choose that part of Black Creek swamp lying just behind the old Bacot Place. Here the tall, flat-crowned cypress trees reach high above all else, and give an impressive dignity to the place. Reaching nearly to their lower branches are fine specimens of black gum and tulip tree, and beneath these are smaller trees of red maple, juniper and sweet bay.

The undergrowth, which is rather dense, consists of fetter bush (*Lyonia nitida*), Virginia willow (*Itea virginica*), large gall-berry (*Ilex lucida*), a little of the small gall-berry (*Ilex glabra*), both 'possum haws (*Viburnum nudum* and *Viburnum cassinoides*), swamp azalea (*Azalea vicosa*), poison sumach (*Rhus Vernix*), male berry (*Lyonia ligustrina* var. *foliosiflora*), high blackberry (*Rubus Andrewsianus*), and Alder (*Alnus rugosa*). It was a little surprising to find here on the highest tussocks a little holly (*Ilex opaca*),

myrtle (*Cyrilla racemiflora*) and French mulberry (*Callicarpa americana*). The two last are at their best in a sunny exposure, and are not noticeable constituents of swamps. *Mikania scandens* clambered about among the shrubs, and cross vine (*Bignonia capreolata*) and poison ivy (*Rhus Toxicodendron*) ascended high into the trees.

In the shallow water or saturated soil there was a considerable herbaceous growth of marsh St. John's-wort (*Hypericum virginicum*), lizard's tail (*Saururus cernuus*), joe-pye weed (*Eupatorium maculatum*), *Mayaca Aubletii*, some cinnamon fern (*Osmunda cinnamomea*), and chain fern (*Woodwardia areolata*) in abundance. Near the large spring on the edge of the swamp at this place were lady fern (*Asplenium Filix-femina*), and several plants of the grape fern (*Botrychium virginianum*), which were the only specimens of this interesting species that I have found in Hartsville.

Three of the most attractive and interesting of our swamp plants were not noted in the immediate spot just described, but all three of them are conspicuous in that bit of swamp lying between the dam and the creek crossing at the paper mill. They are wild wistaria (*Wistaria frutescens*), Walter's smilax or red-berried bamboo (*Smilax Walteri*) and Storax (*Styrax americana*). The wistaria is very like the Chinese one that, in two shades —purple and white—is grown for ornament. It blooms about three weeks later than the Chinese, and its flowers are borne in smaller clusters and are deeper colored than in that species. Our vine is offered for sale by nurserymen and there is an improved form (variety *magnifica*) that is more floriferous in cultivation than the wild plant.

Walter's smilax climbs up as high as twelve feet or more into the trees, and in winter it makes a beautiful show with its bright scarlet berries. It was named for one of the best known early botanists of America, Thomas Walter, of South Carolina.

The storax generally grows along the creek margins or other open spots where it can get some sunlight. It is a good sized bush that bears a profusion of pretty bell-shaped white flowers in mid-

Dead Cypress tree in Prestwood's Lake with a collar of shrubs.

dle April. It, too, is sold by dealers and is well worthy of cultivation.

The tall cane (*Arundinara macrocarpa*) grows plentifully in the deep, rich soil of swamps, preferring the better lighted edges of the streams, and the dwarf cane (*Arundinaria tecta*) is abundant on the edges of bays and ponds. I have never known either species to fruit at Hartsville, though they probably do so at long intervals.

In the open swampy places below the dam there is in July a handsome display of the white flowers of *Sabatia lanceolata* and the greenish yellow flat-topped cymes of *Polygala cymosa*. Earlier in the season the small white flowers of the swamp fleabane (*Erigeron vernus*) are numerous enough to be quite conspicuous.

THE LAKES AND PONDS.

In many respects the margins of the more extensive bodies of water duplicate certain of the conditions already described, but it is not so at all points, and it is best to include the marginal growth in any discussion of their vegetation. I shall first consider the flora of

PRESTWOOD'S LAKE.

This artificial lake was formed by the damming of Black Creek by the Carolina Fiber Company about eighteen years ago. The lake itself may be said to extend for a little over a mile, but there is back water in the creek run for nearly a mile and a half. The width of the lake is about a quarter of a mile across at its broadest part.

When the swamp was cleared in preparation for the lake it was decided as an experiment to leave several very large cypress trees in the deeper part near the dam and test the effect of the altered conditions. Standing in about twelve feet of water they continued to live for three or four years, but got weaker all the time and at last gave up the struggle. In the upper end of the lake a considerable section of the swamp was left uncut, and although the depth there is only about five or six feet, the results have been the same so far as the larger trees are concerned. The small cypress trees have for some reason shown greater adaptability.

and many of them are left in apparrently good health. They grow very slowly but bear fruit abundantly. The only plants of the original growth that have remained alive with their roots under five feet or more of water are cypress, red maple (*Aver carolinianum*), myrtle (*Cyrilla recemiflora*), storax (*Styrax americana*), bamboo briar (*Smilax laurifolia*), and Walters' smilax (*Smilax Walteri*).

In Plate XI is shown this part of the lake. The large dead cypresses are seen in the background, and a number of small live ones are seen in the front. In the middle foreground is a large bush ot alder (*Alnus ruyosa*), growing on a stump. The mossy-looking growth hanging from the tops of some of the dead trees in the lichen *Usnea barbata*.

The stumps, floating logs and standing dead trees support a large population of shrubs and herbs. The dead cypress shown in Plate XII has a dense collar of shrubs and young trees surrounding it at water level. Here are growing Carolina red maple (*Acer carolinianum*), juniper (*Chamaecyparis thyoides*), fetter bush (*Lyonia nitida*), myrtle (*Cyrilla racemiflora*), sweet pepper bush (*Clethra alnifolia*), *Zenobia pulverulenta* and *Lyonia ligustrina var. foliosiflora*. These plants were all rooted to the decaying bark of the cypress, five and a half feet above the lake bottom.

Some of the floating logs carry such a profusion of gay flowers as to look like miniature gardens. On one of these I have noted the following: juniper (*Chamaecyparis thyoides*), Carolina red maple (*Acer carolinianum*), alder (*Alnus rugosa*), fetter bush (*Lyonia nitida*), *Zenobia pulverulenta*, *Leucothoe racemosa*, myrtle (*Cyrilla racemiflora*), *Hypericum verginicum*, *Hypericum canadense*, sundew (*Drosera intermedia*), *Utricularia juncae*, *Xyrus caroliniana*, and species of *Rynchospora*.

The aquatic plants of the lake are: *Brasenia Schreberi* (water shield), *Nymphoides aquaticum* (floating heart), *Potamogeton diversifolius*, *Potamogeton heterophyllus*, *Nymphaea advena* (yellow pond lily), *Utricularia fibrosa* (bladderwort), *Utricularia biflora* (bladderwort), and *Mayaca fluviatilis*.

The Mayaca is new to South Carolina, not having been reported before north of the Gulf States. It is a very delicate plant,

A dense colony of Water Shield (Brasenia Schreberi) covering the water on the south side of Prestwood's Lake.

growing in considerable masses, entirely submerged in rather shallow water* The yellow pond lily has made an entrance in the last few years. About four years ago I noticed one plant at about the spot shown in Plate XI. Now there are a dozen or more colonies in that part of the lake.

Water shield is now the most conspicuous aquatic plant of the lake. Its small floating leaves coated on the under side with a beautiful clear jelly cover the water in large areas near the edges. A dense colony of it is shown in Plate XIII.

Nymphoides aquaticum (*Limnanthemum*), with large floating leaves that look much like those of the water lily, is not abundant: in fact, it appears to be much less so than it was several years ago.

It is rather surprising that the water lily (*Castalia odorata*) and the small floating heart (*Nymphoides lacunosum*) have not yet made an entrance into the lake. They are plentiful in Kilgore's Mill Pond, only about a mile away.

Over a considerable area of the lake near the edge behind Captain Cannon's Place the water is only a few inches deep, forming a bog. The swamp had been cleared off here just before the water was raised, but it is now covered with a rather dense second-growth of the following plants: *Taxodium distichum* (cypress), *Salix nigra* (black willow), *Alnus rugosa* (alder), *Cephalanthus occidentalis* (button bush), *Callicarpa americana* (French mulberry), *Viburnum nudum* ('possum haw), *Nyssa sylvatica* (black gum), *Itea virginica* (Virginia willow), *Boemeria scabra*, *Typha latifolia* (cat-tail), *Saururus cernuus* (lizard's tail), and *Peltandra virginica* (moccasin corn). Climbing over the shrubs in great abundance was *Mikania scandens*.

On the muddy shore, not covered with water, there is a good colony of young *Pinus Taeda* (old-field pine). Near them, in addition to most of the above, were *Magnolia glauca*, *Clethra alnifolia* *Cyrilla racemiflora*, *Liquidamber Styraciflua*, *Lyriodendron tulipifera*, *Ilex glabra*, *Rubus Andrewsianus*, *Decodon verticillatus*, and the

*There is some doubt as to distinctness of *Mayaca fluviatilis*. It may be nothing more than a submerged form of *M. Aubleti*.

ferns *Osmunda cinnamomea* and *Woodwardia areolata*.

Where the border of the lake is a gentle sandy slope, as it is on the south side above Prestwood's Bridge, the first vegetation consists of large patches of the grass *Panicum hemitomum* in shallow water; behind this in shallow water and on the muddy edge is the larger grass *Panicum scabriusculum;* then handsome clumps of the tall yellow-flowered *Xyris fimbriata* and large pipewort, or "hat pins" as we call it (*Eriocaulon decangulare*), with flowers in compact white balls. Mixed with the last two or just behind them are *Iris versicola*, *Iris prismatica*, *Hypericum verginicum* (Elodea), *Proserpinaca pectinata*, *Sclerolepis unifiora* (a pretty little pink-flowered composite), *Utricularia juncea*, *Xyris caroliniana*, *Drosera intermedia*, *Mayaca Aubleti*, *Lycopus pubens*, *Ludwigia linearis*, *Stachys hyssopifolia*, *Rotala ramosior*, and *Polygala lutea*. Here also was discovered a fine colony of the orchid *Hebenarea Nuttalii*, with greenish flowers, a species not before found in the State of South Carolina.

A little behind these as a rule were *Carphephorus bellidifolius*, *Diodia virginiana*, *Ascyrum hypericoides*, *Spiranthes praecox*, *Limodorum tuberosum*, *Rhexia ciliosa*, *Bartonia lanceolata*. The large ferns *Osmunda cinnamomea* and *Woodwardia virginica* were conspicuous here, and the smaller *Woodwardia areolata* and *Lycopodium alopecuroides* were abundant. *Lycopodium adpressum* occupied slightly less wet situations.* Mingled with these herbs were scattered clumps of sweet pepper bush (*Clethra alnifolia*), swamp azalea (*Azalea viscosa*), low gallberry (*Ilex glabra*), fetter bush (*Lyonia nitida*), *Zenobia pulverulenta*, alder (*Alnus rugosa*), button bush (*Cephalanthus occidentalis*), myrtle (*Cyrilla racemiflora*), groundsell tree (*Baccharis halimifolia*) and yellow jessamine (*Gelsemima sempervirens*); also small young trees of cypress (*Taxodium distichum*), Carolina red maple (*Acer carolinianum*), black willow (*Salix nigra*), and juniper (*Chamaecyparis thyoides*). Still farther up where the soil was damp but not soaked, where the white goldenrod (*Solidago* sp.), *Galactia regularis*, meadow beauty (*Rhexia lanceolatat*, nearly white), *Rubus Andrewsianus*, *Vaccinium vaccillans*, *Gaylussacia frondosa*, *Gaylussacia dumosa*, *Rhus copalina*, *Pteris aquilina*, *Vitis rotundifolia* and *Diospyros virginica*.

*See notes by me on these two species of *Lycopodium* in THE FERN BULLETIN, Vol. 17, July, 1910.

A large Holly tree (Ilex opaca) near the lake.

On the upper edge of this society was a large clump of male plants of *Ilex carolinana*. A little farther back a low sandy ridge supported almost the typical growth of the sand hills, with long-leaf pine (*Pinus palustris*), turkey oak (*Quercus Catesbaei*), black-jack oak (*Quercus marylandica*), upland willow oak (*Quercus cinerea*), post oak (*Quercus stellata*), sparkleberry (*Viburnum arboreum*), poison oak (*Rhus quercifolia*), and wire grass (*Aristida stricta*) as the most conspicuous vegetation.

On the more or less wet edges of the lake at other points were collected the following: *Lysimachia terrestris*, *Radbeckia hirta*, *Sabatia brachiata*, *Hypericum fasciculatum* (a good sized heath-like bush), *Bradburia virginica*, *Ludwigia alternifolia*, *Apios tuberosa* (known as "ground nut" on account of its numerous edible underground tubers), *Jussiaea decurrens*, *Myrica cerifera*, *Wistaria frutescens*, *Carex macrokolea* and *Scirpus Eriophorum*. The last is one of the handsomest herbaceous plants of the lake edge.

Just above the dam on the northern side there is in late summer a conspicuous show of the large white plumes of the very tall grass *Erianthus saccharoides*. I have not noticed golden club (*Orontium aquaticum*) in the lake, but in the run of Crowley's branch just above the old broken dam there is a fine lot of this interesting plant. It is a member of the same family as the calla lily, but has no spathe around its fleshy, yellow spike of flowers. It may be seen at many of the branch crossings in our section. The moccasin corn (*Peltandra virginica*), which is so plentiful in the shallow water of the lake edge, is a member of the same family.

On the low earth dam across the lake from the paper mill was collected *Solidago verna* (spring goldenrod) for the first time in South Carolina.* Other plants collected on this dam were *Smilax glauca*, *Rhynchosia simplicifolia*, *Penstemon laevigatus*, *Apocynum pubescens*, *Lactuca graminifolia*, and *Erigeron ramosus*.

*See my "Additions to the Flora of the Carolinas," in BULLETIN TORREY BOT. CLUB. Vol. 36, page 635, 1909. I have since found this species to be plentiful in the low woods near the lake. By June 1st of this year (1911) its blooming period was nearly over.

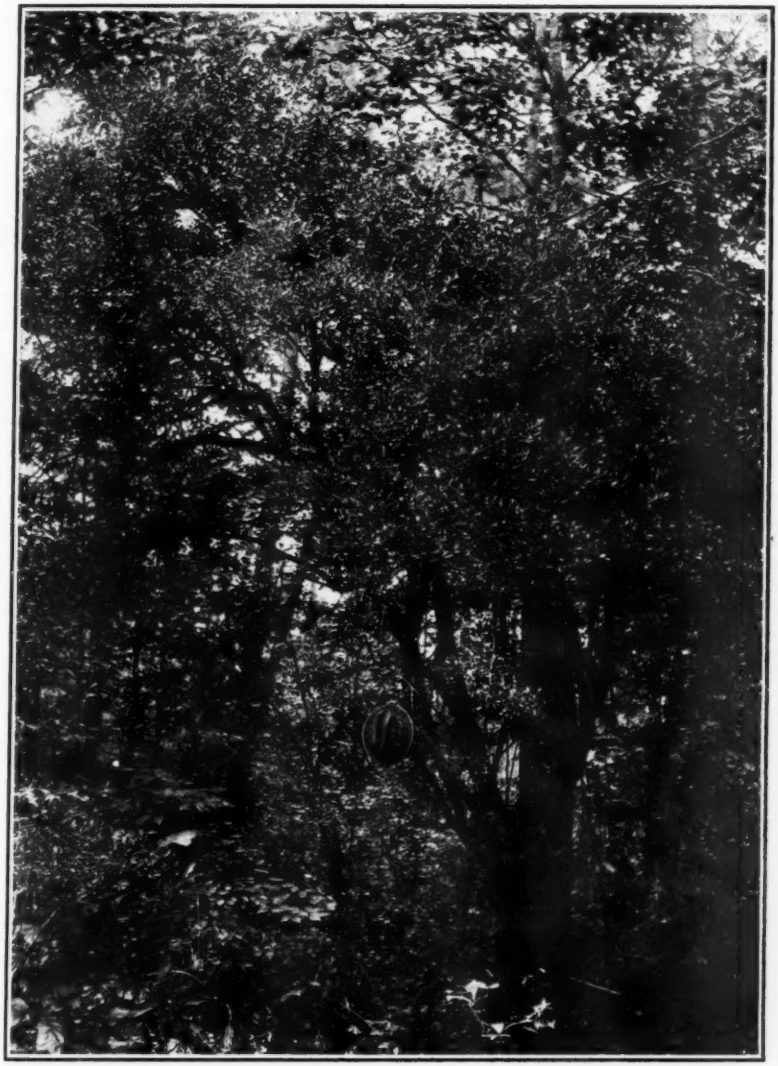
KILGORE'S MILL POND.

This is a small body of water, much older than Prestwood's Lake, that lies in the low sand hills about one mile northeast from Hartsville. A study of the vegetation and its surroundings resulted in the collection of a considerable number of plants not seen around Prestwood's Lake. *Nymphoides lacunosum*, not found in the lake, was abundant here with *Nymphoides aquaticum*, and submerged in the stream just below the mill race was *Scirpus subterminalis*, not before reported south of New Jersey (but I find a collection of it in the N. Y. Bot. Garden from Mississippi).*

On the west side of the pond is a flat marsh, inundated generally with several inches of water, which is covered almost all over with a pure growth of *Eleocharis melanocarpa*. In deeper spots this is replaced by *Eleocharis quadrangulata*. On the edges of this marsh grew abundantly *Rynchospora glomerata* and *Fuirena squarosa*. *Juncus repens* grew in dense patches in the shallow water, while *Rynchospora corniculata* and *Juncus scirpoides* were scattered on the margins. *Utricularia juncea* also grew sparingly here, but on the other side of the pond it was so plentiful in the shallow water as to give a marked yellow color to the margin. In the same situation on the east side was the little *Eleocharis Torreyana*, partly submerged and mixed with *Mayaca Aubleti* and some *Nymphoides lacunosum*. Behind these was a zone containing clumps of the large, handsome *Xyris fimbriata* mixed with the smaller *Xyris elata* and with *Ascyrum hypericoides*, *Proserpinaca pectinata*, *Schlerolepis uniflora* and some large "hat pins" (*Eriocaulon decangulare*). Back of this zone is a dense growth of the large grass *Pinicum scabriusculum*, with some of the attractive tall sedge *Scirpus Eriophorum*. With these were a few small scattered individuals of *Alnus rugosa*, *Nyssa biflora* and *Acer carolinianum*. In about this situation were found a number of specimens of the greenish white orchid *Habenaria clavellata*, one of the rarest of our plants.

This zone passes beyond into a flat moist bay of poor soil

*See my "Additions to the Flora of the Carolinas," in BULLETIN TORREY BOT. CLUB. Vol 36, pape 635, 1909.



A large tree of Sparkleberry (Vaccinium arboreum) near Black Creek

covered with an open growth of stunted trees and shrubs. *Nyssa biflora* and *Acer carolinianum* were the largest growth, and among them were *Alnus rugosa*, *Magnolia glauca*, *Rhus copalina*, *Rhus Vernix*, *Myrica pumila*, *Ilex glabra*, *Ilex lucida*, *Cyrilla racemiflora*, *Lyonia nitida*, *Prunus serotina*, *Viburnum nudum*, *Viburnum cassinoides*, *Rhus Toxicodendron*, *Rubus Andrewsianus*. Scattered here and there were a few small trees of *Pinus palustris*, *Pinus serotina* and *Chamaecyparis thyoides*. It was rather surprising to find in such a place large quantities of broom sedge (*Andropogon virginicus*). The smaller growth was *Pluchae foetida*, *Eupatorium maculatum*, *Eupatorium rotundifolium*, *Rhexia mariana*, *Centella repanda*, *Osmunda cinnamomea*, *Woodwardia areolata* and *Lycopodium alopecuroides*.

In a small wet meadow to the east of the pond were collected *Polygonum hydropiperoides*, *Scutellaria integrifolia*, *Oldenlandia Boscii*, *Bacopa acuminata*, *Viola lanceolata*, *Gratiola pilosa*, *Diodia virginiana*, *Aster cordifolius*, *Linum striatum*, and *Hypericum virgatum*.

Along the wet crossing below the mill *Verbena polystachya* was picked up; and in slightly damp soil near here were *Hieracium Gronovii*, *Kneiffia arenicola*, *Crotalaria rotundifolia* and *Helianthemum majus*.

On the dam grew *Wistaria frutescens*, and in the damp woods on the west side were a number of plants of *Berchemia scandens* (supple jack), a vigorous high-climbing vine, and one of the rarest woody pants of Hartsville. There is a good specimen of it at the Snake Branch crossing, just above the paper mill.*

*This article is the first part of a larger pamplet, containing a systematic list and other information in regard to Hartsville plants, that is soon to be published by the Pee Dee Historical Society, Hartsville, S. C.